STATISTICAL EVALUATION OF DEPARTMENT OF ENERGY D&D OCCURRENCES

August 1998

U.S. Department of Energy
Assistant Secretary for Environment, Safety and Health
Office of the Deputy Assistant Secretary for Worker Health and Safety

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CONTENTS

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GLOSSARY OF TERMS AND PHRASES

Characterization The process of identifying hazards through the collection and evaluation of facility data. Characterization activities should be considered if knowledge of hazards is insufficient to understand hazardous substance types, quantities, forms, potential exposures, and locations.

Consequence The effect associated with the personnel or environmental exposure to a hazard.

Deactivation The process of placing a facility in a safe and stable condition including the removal of readily removable hazardous and radioactive materials to minimize the long-term cost of a surveillance and maintenance program that is protective of workers, the public, and the environment. Deactivation activities can include one-of-a-kind and first-of-a-kind tasks, such as removal of radioactive materials in ventilation duct work. It also includes routine surveillance and maintenance tasks that are typically part of facility operation.

Decommissioning Takes place after deactivation and includes surveillance and maintenance, decontamination, and/or dismantlement. These actions are taken at the end of the life of a facility to retire it from service, with adequate regard for the health and safety of workers and the public and protection of the environment. The ultimate goal of decommissioning is unrestricted release or restricted use of the site. Surveillance and maintenance tasks conducted during decommissioning are typically routine activities that are similar to any other life-cycle phase. A disposition project or activity can also be in long-term surveillance and maintenance (e.g., quiescent state) if no deactivation, decontamination, and/or dismantlement activities are conducted. This definition is not meant to imply that Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the controlling regulation for long-term surveillance and maintenance when decommissioning is not immediately undertaken.

Decontamination The removal or reduction of residual radioactive and hazardous materials by mechanical, chemical, or other techniques to achieve a stated objective or condition. Decontamination may occur during all phases of facility decommissioning; however, the greatest decontamination activity usually occurs during decommissioning.

Demolition The activities associated with the physical removal of the facility including its structure.

Dismantlement The disassembly or demolition and removal of any structure, system, or component during decommissioning and satisfactory interim or long-term disposal of the residue from all or portions of the facility.

ES&H Deficiency A failure, problem, or condition that has either a causative or correlative association with a related occurrence. In this study, the ES&H deficiencies are categorized by the ISMS core functional areas: Define the Scope of Work, Analyze the Hazards, Develop and Implement Controls, Perform Work within Controls, and Provide Feedback and Continuous Improvement. The ISMS core functions are defined in DOE P 450.4, *Safety Management System Policy*.

Facility Disposition The final stages of a facility's life-cycle, encompassing long-term surveillance and maintenance after stabilization, deactivation, post-deactivation long-term surveillance and maintenance, and decommissioning.

Hazard A chemical property, energy source, or physical condition that has the potential to cause illness, injury, death to personnel, or damage to property or to the environment, without regard for the likelihood or credibility of potential accidents or the mitigation of consequences.

Occurrence Events, incidents, accidents, or conditions that occur at DOE facilities and are reported in the Occurrence Reporting and Processing System (ORPS) in accordance with DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*. This system provides information on unusual, off-normal, and emergency events at DOE-owned and -leased facilities/areas.

Remediation The activities associated with cleaning up the non-facility areas (or areas remaining after removal of the facility) and restoring these areas to their original or planned use condition.

Restoration The activities associated with returning areas to their original or planned use condition. This may include refurbishing facilities and accesses and revegetation.

Sampling The physical activity of collecting information (typically soil or well samples to determine the types and magnitudes of hazards present) on a facility/area as part of characterization.

Surveillance and Maintenance (S&M) These activities are conducted throughout the facility life-cycle phase including when a facility is not operating and is not expected to operate again and continues until phased out during decommissioning. Activities include providing in a cost-effective manner periodic inspections and maintenance of structures, systems, or equipment necessary for the satisfactory containment of contamination and the protection of workers, the public, and the environment. A disposition project can be in a quiescent state of long-term surveillance and maintenance prior to deactivation or prior to decommissioning.

Surplus Facilities Also referred to as "Excess Facilities," these are physical assets that are not required for DOE needs and the discharge of its responsibilities (i.e., DOE facilities that no longer have a mission). These are the facilities that are being transitioned into facility disposition.

ACRONYMS

AH	Analyze the Hazards *(ISMS Core Function)*
APH	Asphyxiation *(ES&H Consequence Type)*
B	Biological Exposure/Contamination *(ES&H Consequence Type)*
BIO	Biological Hazards *(Hazard Type)*
BN	Burn *(ES&H Consequence Type)*
CC	Inadequate Change Control *(ES&H Deficiency Subarea of PW)*
CE	Personnel Chemical Exposure *(ES&H Consequence Type)*
CEC	Chemical Environmental Contamination *(ES&H Consequence Type)*
CHAR	Characterization *(Work Type Category)*
CHM	Chemical Hazards *(Hazard Type)*
CIC	Personnel Chemical Internal/Inhalation-Ingestion Contamination *(ES&H Consequence Type)*
CSC	Personnel Chemical External/Skin Contamination *(ES&H Consequence Type)*
D&D	Deactivation and Decommissioning
DEAC	Deactivation *(Work Type Category)*
DECM	Decommissioning *(Work Type Category)*
DECN	Decontamination *(Work Type Category)*
DEMO	Demolition *(Work Type Category)*
DISM	Dismantlement *(Work Type Category)*
DOE	Department of Energy
DW	Define the Scope of Work *(ISMS Core Function)*
EF	Equipment Failure *(ES&H Deficiency Subarea of PW)*
EH-5	Office of Worker Health and Safety
ES	Electric Shock *(ES&H Consequence Type)*
ES&H	Environment, Safety, and Health
FB	Provide Feedback and Continuous Improvement *(ISMS Core Function)*
FE	Fire/Explosion *(ES&H Consequence Type)*
HA	Inadequate Hazard Analysis *(ES&H Deficiency Subarea of AH)*
HC	Develop and Implement Controls *(ISMS Core Function)*
HE	Human Error *(ES&H Deficiency Subarea of PW)*
HI	Inadequate Hazard Identification *(ES&H Deficiency Subarea of AH)*

ISMS	Integrated Safety Management System
IT	Impact/Trauma *(ES&H Consequence Type)*
IWK/CON	Inadequate Work or Hazards Control Practices *(ES&H Deficiency Subarea of HC)*
LC	Legacy Contamination *(ES&H Deficiency Subarea of FB)*
NM	Near Miss
OEWS	Operating Experience Weekly Summary
ORPS	Occurrence Reporting and Processing System
PC	Puncture/Cut *(ES&H Consequence Type)*
PHE	Physical Exposure Hazards *(Hazard Type)*
PHT	Physical Trauma Hazards *(Hazard Type)*
PPE	Personnel Protective Equipment
PRO	Inadequate Procedures *(ES&H Deficiency Subarea of HC)*
PRO	Failure to Follow Procedures *(ES&H Deficiency Subarea of PW)*
PW	Perform Work within Controls *(ISMS Core Function)*
RAD	Radiological Hazards *(Hazard Type)*
RE	Personnel Radiological Exposure *(ES&H Consequence Type)*
REC	Radiological Environmental Contamination *(ES&H Consequence Type)*
RIC	Personnel Radiological Internal/Inhalation-Ingestion Contamination *(ES&H Consequence Type)*
RSC	Personnel Radiological External/Skin Contamination *(ES&H Consequence Type)*
S&H	Safety and Health
S&M	Surveillance and Maintenance
SAMP	Sampling *(Work Type Category)*
STF	Slip/Trip/Fall *(ES&H Consequence Type)*
T	Inadequate Training *(ES&H Deficiency Subarea of HC)*
V	Viral Exposure/Contamination *(ES&H Consequence Type)*

EXECUTIVE SUMMARY

This report presents the analysis of Department of Energy (DOE) deactivation and decommissioning (D&D) occurrences reported during the period June 1990-August 1997. The study was performed by the Office of Worker Health and Safety (EH-5), Office of Field Support (EH-53) to better understand and identify the nature, frequency, and severity of safety and health (S&H) accidents and incidents that have occurred during D&D activities. The primary purpose of this study was to identify S&H deficiencies for D&D-related occurrences from the perspective of the five core functions of the Integrated Safety Management System (ISMS), DOE P 450.4, *Safety Management System Policy*.

D&D involves unique work activities that can potentially expose workers and the environment to a multiplicity of radiological, industrial, chemical, structural, and biological hazards. Within the past seven years, the time wherein D&D work across the complex became a recognized and significant element of the department's cleanup mission, over 6,000 D&D-related occurrences have been reported. As the inventory of surplus facilities requiring dispositioning increases, the probability of more accidents and incidents will likely also increase without active intervention. This said, the analysis described in this report may help predict possible trends or at least help provide a snapshot or more prevalent issues in terms of hazard types encountered during D&D work and the nature of environmental and worker safety and health impacts resulting from exposures to these hazards.

Almost half of all the analyzed D&D occurrences involving hazardous and radioactive material removal activities were related to deficiencies in the ISMS core function associated with feedback mechanisms. The hazard to which workers were most often potentially exposed during this activity were radiological in nature, and most often related to legacy contamination. However, in terms of severity of ES&H consequences, most were rated as relatively insignificant. Overall, over half of all the occurrences analyzed had hazard control and work performance deficits that likely contributed to the particular occurrence ensuing. Severity measures identified for the sampled occurrences also indicate a potential for a chronic, low-level incidence of radiological exposure and contamination events with relatively insignificant ES&H impacts.

The relationships identified in this study between the root causes of D&D occurrences and sound work performance (e.g., preparing, documenting, following, and enforcing proper procedures), and appropriate hazards control and hazards identification, will hopefully underscore the importance of a strong safety management system that can help managers and workers address the unique issues associated with D&D work such as the ubiquitous presence of legacy contamination, and the coexistence of several hazard types that workers may encounter during work performance.

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1.0 INTRODUCTION

This report provides the results of a safety and health (S&H) analysis of Department of Energy (DOE) D&D occurrences during the period beginning June 1990 and ending August 1997. Deactivation and decommissioning (D&D) activities are defined in DOE O 430.1, *Life Cycle Asset Management*, and are applied or executed when a facility has ceased to operate for the purpose of a defense, research, or other mission and end when the facility is dismantled, demolished, entombed, or released for reuse. D&D cleanup activities comprise deactivation and decommissioning, which includes decontamination, dismantlement/demolition, and long-term surveillance and maintenance. The information in this report has also been provided as an added tool in combination with other environment, safety, and health (ES&H) integration efforts such as those described in DOE–STD–1120–98, *Integration of Environment, Safety and Health into Facility Disposition Activities*, and DOE G 450.4–1, *Integrated Safety Management System Guide* (for use with DOE P 450.4, *Safety Management System Policy*), to help D&D managers improve field implementation of safety management principles.

1.1 Purpose and Scope

The assembly of this report is one of several activities performed by the Office of Worker Health and Safety (EH-5) to help illustrate and validate the importance of the safety management principles embodied in the Integrated Safety Management System (ISMS) described in DOE P 450.4. This analysis was conducted to inventory and better understand D&D- related ES&H vulnerabilities that can potentially be eliminated or reduced by the vigilant application of ISMS principles. An attempt was made to find trends associated with particular adverse ES&H consequences and impacts vis-a-vis a predetermined set of analysis criteria in order to:.

- identify ES&H vulnerabilities or deficiencies, which correlate closely with the five core functions of the ISMS, that may have contributed to the occurrences analyzed;
- identify aspects of the ISMS core functions that need particular attention or bolstering and recommendations for their improvement; and
- identify recommendations for improving the department's systems for reporting and assessing D&D occurrences based on insights gained from conducting this analysis.

The scope of the analysis results presented in this report extends to a random and representative sample of D&D occurrences from the occurrence sets contained within DOE's Occurrence Reporting and Processing System (ORPS) and Operating Experience Weekly Summary (OEWS) databases. Separately, two occurrences were evaluated that involved fatalities during D&D activities. The selection of occurrences for analysis were restricted to those whose primary activity involved facility disposition. Although long-term surveillance and maintenance (S&M) activities are considered a significant phase of facility disposition, and numbered in the thousands as data points contained within the two sampled databases, for expediency, long-term S&M activities were not analyzed for this report phase, and may be part of future, related analysis activities, studies, and reports.

1.2 Background

One result of DOE's shift away from nuclear weapons production has been a rapid increase in the number of surplus facilities. Many of these facilities are decades old and have not only physically degraded but are also contaminated with often unknown amounts and types of radioactive and chemical materials. The cleanup of thousands of aging and contaminated facilities requires the performance of unique work activities and potential for exposure to hazards seldom encountered during facility operations. Because these conditions can pose significant safety and health risks to the public, workers, and the environment--over 6,000 D&D-related occurrences have been reported since 1990--a large portion of the overall DOE mission has been dedicated to the dispositioning of these aged facilities. In executing its new mission, the department, through the Office of Environment, Safety and Health (EH), has had to establish aggressive and cost-effective goals not only to address worker protection but also to address other impediments to ES&H as well, including:

- a lack of departmental policy, guidance, and performance measures for facility disposition ES&H programs;
- inadequate hazards management;
- insufficient and inadequate contractor/subcontractor performance oversight;
- ES&H requirements written primarily for facility operations and not disposition; and
- minimal corporate level safety and health guidance for implementing effective safety management systems.

In 1993, EH's Office of Worker Health and Safety initiated a corporate service program designed to provide D&D managers in the field the tools, guidance, and expertise to address these impediments. Among the critical data that EH-5's D&D ES&H corporate service program requires in order to provide high-utility field support are those associated with specific ES&H deficiencies, vulnerabilities, and hazards during D&D activities that have and can continue to compromise worker, public, and environmental protection. One venue for assembling these data is to analyze, from a safety management perspective, the reported occurrences, accidents, and incidents that resulted during the conduct of D&D work.

2.0 APPROACH/METHODOLOGY

2.1 Data Collection

For this study, the DOE Occurrence Reporting and Processing System (ORPS) database and the Operating Experience Weekly Summary (OEWS) reports were selected as the primary sources for D&D occurrence events. DOE and its contractors are required by DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*, and DOE M 232.1-1A, to establish and maintain a system for reporting various categories of incidents related to DOE-owned and -leased facilities. The ORPS database provides information on the types and causes of unusual, off-normal, and emergency occurrences, as well as corrective actions.

The ORPS search was further augmented by similarly searching the OEWS reports, which are published biweekly. Because the OEWS typically provides more information on featured ORPS occurrences, it was used to glean more explanation or detail for D&D-related ORPS occurrences.

2.2 Selection of D&D Occurrences for Analysis

Searches of the ORPS Facility Decontamination and Decommissioning activity category yielded 658 occurrence reports for the designated analysis period beginning June 1990 through August 1997. Some occurrences however, contained more than one reported incident increasing the set to 792 reported incidents from which representative samples[1] were derived for analysis.

A random sample of 80 occurrences was initially analyzed to test and validate the proposed analytical approach and refine the evaluation criteria (e.g., definitions of ES&H deficiencies, hazards, and ES&H consequences). After the initial sample analysis, an additional 261 occurrences were randomly selected and analyzed to provide a more robust sample size and to gain a better perspective of the ES&H nature of D&D occurrences.

The 341 randomly selected occurrences (261 plus the original 80) represented about 43% of the total number of occurrences within the ORPS Facility Decontamination and Decommissioning activity category. Although the entire set of D&D occurrences were not analyzed, the random sample analysis indicated that about 28% of occurrences within this activity category are not actually D&D. These occurrences involved activities associated with normal facility operations, long-term surveillance and maintenance activities, or remediation activities.

In addition to the random selection and analysis of D&D-related occurrences, all D&D-related occurrences that involved a fatality during the period were identified and evaluated.

2.3 Data Analysis Approach

Once samples were obtained, the analysis was conducted to: (1) verify that the activities involved in each occurrence was D&D-related; (2) identify the ES&H deficiencies involved in each occurrence; (3) identify the hazards; and (4) identify any ensuing ES&H consequences. Results of the analysis are summarized in Section 3 and data are provided in Appendix A. In addition, a ranking scheme was applied to determine the significance of any ES&H impacts to workers and the environment identified in each occurrence.

Types of D&D Activities

While D&D comprises several activity types (see Glossary of Terms and Phrases, page v), the ORPS system uses a specific activity category: Facility Decontamination and Decommissioning.[2] Where sufficient information was provided, the occurrences were defined by more specific D&D work types or activities such as sampling, characterization, deactivation, decontamination, dismantlement, demolition, or decommissioning. This information is

[1] Samples selected based on "Table of Random Units" from the 16th Edition of the CRC Standard Mathematical Tables.

[2] Long-term surveillance and maintenance activities were omitted from the study since they are reported in various categories beyond the ORPS Facility Decontamination and Decommissioning activity category.

contained in Appendix A.

ES&H Deficiencies

ES&H deficiencies associated with a D&D occurrence were defined and categorized according to the five core functions of the ISMS, as shown in **Figure 1**, and as defined in DOE P 450.4, *Safety Management System Policy*.

In those instances where an occurrence related to the discovery of a pre-existing condition involving contamination, the occurrence was identified as having an ES&H deficiency within the ISMS core function *provide feedback and continuous improvement.* This categorization was selected for these occurrences because the contamination event usually took place during facility operations but was discovered or addressed as part of D&D activities.

Hazards and Associated ES&H Consequences

After reviewing the sampled occurrences for the types of hazards that were most often present, four main "hazard types" were identified for analysis: radiological, chemical, physical, and biological. Similarly, a thorough review of the sampled occurrences for the most common or frequently occurring ES&H consequences yielded worker and environmental exposures and contamination and worker injuries and fatalities. Hazard categories and ES&H consequences defined for this analysis are described in greater detail in **Table 1**.[3]

Consistent with the ORPS, for this analysis, ES&H consequences also had the potential to be identified as "near misses," where "near miss" occurrences include conditions that prevented a specific consequence from ensuing in spite of the presence of hazards.

Significance Ranking

All D&D occurrences were also ranked by significance or level of concern related to any identified ES&H impacts or consequences. The ranking methodology used was adapted from the classification scheme used by EH's Chemical Safety

[3] Criticality or other types of hazards were not included in Table 1 only because there were no reported disposition occurrences involving these hazards.

Program within the Office of Field Support, EH-53, to evaluate chemical safety occurrences.[4]

Use of the classification scheme was extended beyond chemical safety-related occurrences to include those occurrences in the study sample that had identified radiological, physical, and biological hazards. Because of its qualitative nature and because information contained within many occurrence descriptions was sometimes incomplete, some subjectivity based on interpretation was required in order to assign a significance rank (i.e., class 1, 2, 3, or 4) to the occurrences. Based on the information provided within the occurrence reports, each occurrence was ranked/classified accordingly:

Class 1: Occurrences with incidents resulting in an injury or exposure requiring hospital treatment or confirmed, severe environmental effect; also occurrences with potential to cause these effects with all safety barriers down, except, for example, that workers were not nearby to be injured or exposed, or escaped in time, or the climate conditions were favorable. ***Very Significant***

Class 2: Occurrences with incidents characterized by minor injury (e.g., first aid/S&H personnel in attendance) or exposure, minor environmental damage, or temporarily uncontained hazards excursions into the environment; also near misses where one additional safety barrier remained to prevent consequences to those in class 1. ***Relatively Significant***

Class 3: Potential precursors to occurrences in class 1 or 2. ***Minor Significance***

[4] August 11, 1997 Memorandum, EH-53, Sastry, 301-903-4664.

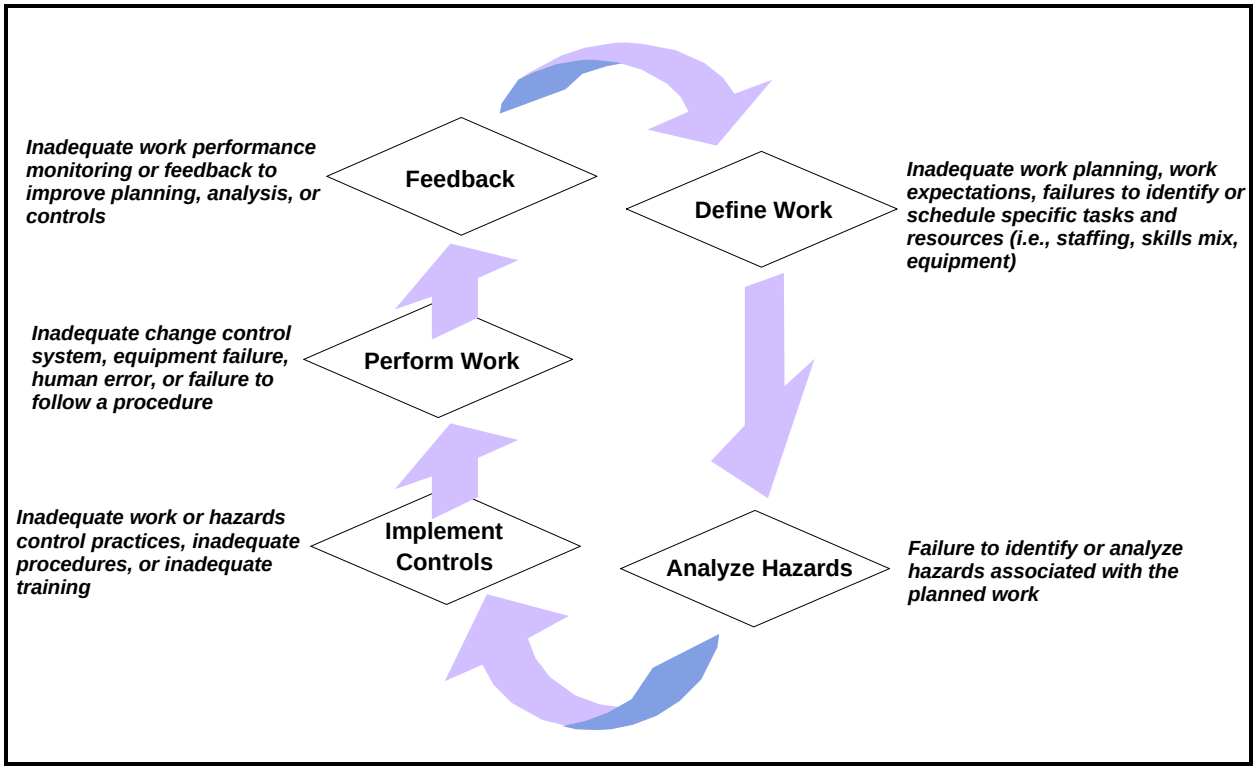

Figure 1 - ES&H Deficiencies Categorized by ISMS Core Functions

Hazard	Description	Associated ES&H Consequences
Radiological	Radioactive particulate, contamination, and source material	Radiological exposures, internal/inhalation-ingestion, external/skin, environmental contamination
Chemical	Hazardous chemicals/materials and contamination	Hazardous chemical/material exposures, internal/inhalation-ingestion, external/skin, environmental contamination
Physical Trauma	Physical impacts to workers	Impact/trauma, puncture wounds, cuts, slips/trips/falls
Physical Exposure	Confined space hazards, heat, and external energy sources	Burns, fire/explosion, electric shock, asphyxiation
Biological	Hazards associated with animals, insects, and poisonous plants	Biological (e.g., viruses, toxins, and infections)

Table 1 - Hazards and Consequences Used in the Data Analysis

Class 4: Minor but potentially frequent occurrences, such as leaks, spills, releases, and excursions frequently with no ES&H consequence or impact. ***Insignificant***

Examples of situations typically found within occurrence descriptions for each class are presented in **Table 2**.

Significance Ranking	Radiological[5]	Chemical	Physical
Class 1	▸ Exposures causing irreversible effects ▸ Inhalation/Ingestion detectable from bioassay ▸ Large release of material	▸ Exposures causing irreversible effects (e.g., exposure to carcinogen) ▸ Large release of material	▸ Injury requiring hospital treatment ▸ Lost time injury
Class 2	▸ Exposures with only temporary effects ▸ Inhalation/Ingestion detectable by nasal smear but not from bioassay ▸ External skin contamination	▸ Reversible effects or acute exposure with only temporary effects requiring action (e.g., exposure causing light-headedness or nausea)	▸ Injury resulting in local medical treatment or first aid, but does not involve a lost time injury ▸ Minor cuts and abrasions
Class 3	▸ External clothing contamination	▸ Minor exposure with no personnel effects (e.g., detect unpleasant odor with no effects)	▸ Events or conditions that do not result in injuries, but could under slightly different circumstances ▸ Small load dropped near personnel with no injuries ▸ Discovery of deteriorated facility conditions
Class 4	▸ Minor leaks, spills, or releases with no exposure to personnel ▸ Legacy contamination	▸ Minor leaks, spills, or releases with no exposure to personnel ▸ Legacy contamination	▸ Events or conditions that involve physical hazards that do not result in injuries

Table 2 - Examples of Situations Associated with Significance Ranking

[5] Radiological significance classes 1 and 2 developed using comparable definitions of irreversible and reversible health effects used in the chemical significance classes. "Irreversible effects" is defined as being permanent, with effects of exposure remaining after the substance is eliminated from the organism. "Reversible effects" is defined as having no lasting effect from the exposure. (Stephan F. Austin State University, *Environmental Chemistry*)

3.0 ANALYSIS RESULTS AND OBSERVATIONS

This section summarizes analysis results using the approaches/methodologies described in the previous section. Analysis results are presented via pie chart illustrations of data distributions with accompanying explanations.

In addition to the application of the analysis categories described in section 2.3, a 4-class classification scheme was used to rank occurrences by their severity or significance (significance ranking) for identified ES&H consequences and impact to workers, the public, and the environment. Significance ranking results have been tabulated for all the occurrences in Appendix A Table A7; by hazard type in Appendix A Tables A3 through A5; and by ES&H deficiency in Appendix A Table A6.

After completing searches of the ORPS and OEWS databases using the Facility Decontamination and Decommissioning activity category, D&D-related occurrences reported during the period of June 1990 - August 1997 accounted for about 2%, or 792, of all reported occurrences (38,395) for this same period. Although comprising a relatively small proportion of the occurrences reported for this period, these identified D&D occurrences do not include long-term surveillance and maintenance occurrences for the reasons specified in Section 2.

Of the total number of D&D occurrences identified, nearly half, about 43% (341 of 792), were randomly selected for evaluation. A review of this sample using analysis category **work type** yielded 257 D&D-related occurrences. The random sample analysis indicated that about 28% of occurrences within the Facility Decontamination and Decommissioning activity category are not actually D&D. These occurrences involved activities associated with normal facility operations, long-term surveillance and maintenance activities, or remediation activities.

3.1 ES&H Deficiencies by ISMS Core Function

This analysis used the ISMS core functions to help identify the **ES&H deficiencies** that may have contributed to the D&D occurrence. **Figure 2** gives the percentages of occurrences with ES&H deficiencies in each of the core functions.

As illustrated in **Figure 2,** over 30% of the sampled occurrences had links to deficiencies within the ISMS core function *develop and implement controls*. Not only were occurrences with hazard control problems more frequently ranked as very significant (class 1) or relatively significant (class 2), but over half of all occurrences that had a class 1 or 2 ranking had deficiencies within this core function. Specifically, the deficiencies noted were in training, resulting from inadequate work practices, and hazards control (e.g., occurrence #s 36, 40, 134, 153, and 156).

Inadequate work or hazard control practices were also identified as the primary contributors to the two fatalities occurring within the analysis period. The Oak Ridge burn fatality was heavily linked to the selection and use of inappropriate personnel protective equipment (PPE) for that particular area of work type. The Richland fall fatality was a direct result of not having fall protection while working on a roof that had been identified as structurally unsound and deteriorated.

Establishing and implementing appropriate hazards control during the often unpredictable conditions surrounding D&D work, either by directive or discretion, can involve a variety of hazard control types and techniques. As the Defense Nuclear Facilities Safety Board indicates in their document *Perspectives in the Integration of Safety Management Principles into Decommissioning Of Defense Nuclear Facilities,* because of the nature of D&D work, especially decommissioning, how controls are established or defined are functions of not only identified and unidentified hazards, but also of the changing bases for controls.

For example, D&D work can involve the removal of multiple hazards (e.g., asbestos around old systems and piping often filled with toxic chemicals and gases) and hazardous conditions (e.g., buried electrical cables and dilapidated building structures). It is crucial that controls are established early on in projects based on well-defined, well characterized, or anticipated hazards and workers and managers must remain continuously cognizant of the potential for project changes so that controls can be adapted or retailored.

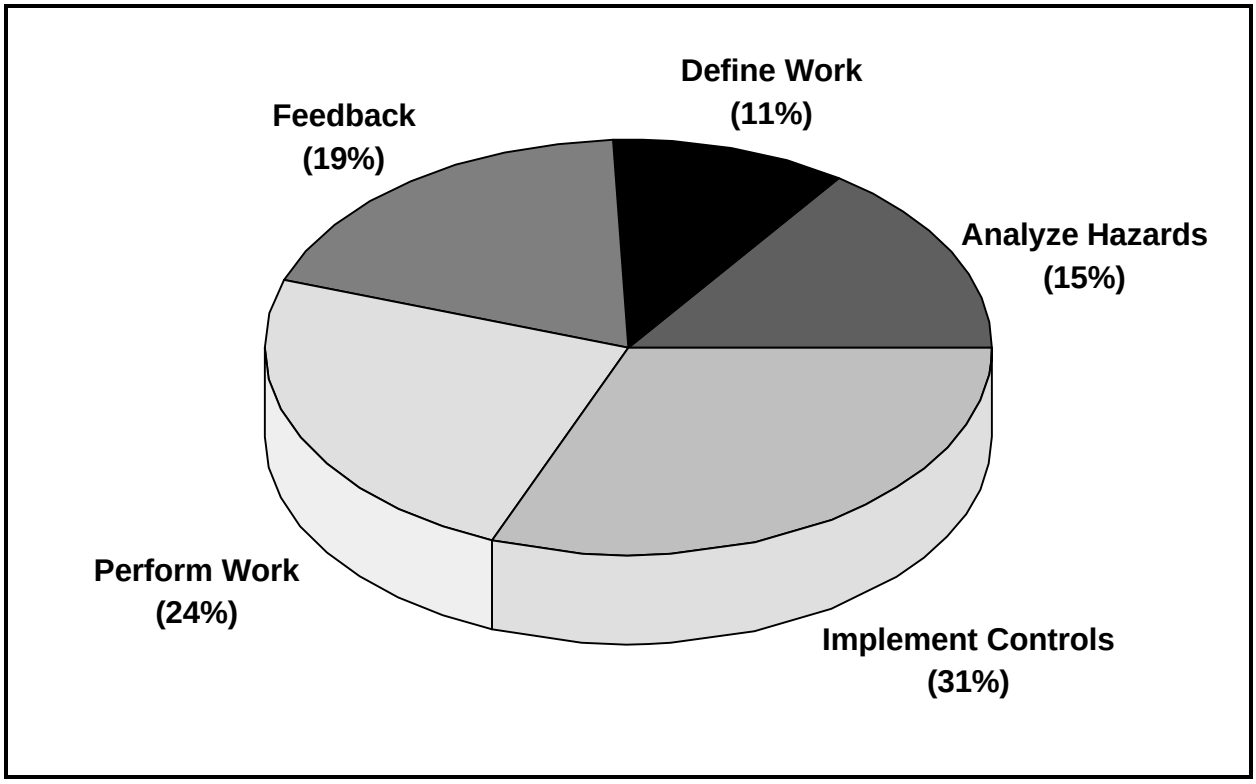

Figure 2 - ES&H Deficiencies by ISMS Core Function

As some of the analysis results suggest, in selecting and implementing hazard controls, managers and workers may not have considered: the full course of the work activity, the type of work being performed, other work activities being performed nearby, the physical conditions of the work (e.g., crawling on knees, the potential for profuse sweating while wearing PPE, and live electrical cables buried nearby), the working environment, and proper worker supervision and training so that work practices and procedures are followed (e.g., occurrence #s 2, 11, 14, 55, 126, and 151).

The next most frequently occurring scenario involving ES&H deficiencies were associated with occurrences that had problems during work performance activities. Sixty-two of the analyzed occurrences had deficiencies within elements of this core function, termed *perform work.* Of this set, almost 60% revealed problems associated with workers failing to follow procedures, where procedures include documented policies, posted warnings, work permits, and written work instruction (e.g., occurrence #s 1, 13, 18, and 34).

Failure to follow procedures during D&D work is particularly essential because of the uniqueness of tasks, jobs, and activities, such as demolition work that may include radiologically contaminated structures and equipment; hazardous chemicals removal; dismantling and cutting old systems that may be laden with hazardous materials, chemicals, or gases; or deteriorated structures. These activities are typically "one-time" events that demand precision and full cognizance with respect to all conditions that impact worker S&H during the efficient conduct of work.

Also, in many instances, workers who may have been trained and familiar with facility operations, may not have received the special training or briefing to allow full awareness of activities or hazards associated with the particular D&D work being

conducted. This lack of familiarity with the specific work scope, as evidenced by the "failure to follow procedures" deficit, resulted in one fall fatality and about half of the occurrences having class 3 significance. A number of occurrences with deficiencies in this core function also had near misses for blunt force trauma ranging in potential severity between class 2 and 4 (e.g., occurrence #s 34, 37, 43, and 51).

The analysis identified an occurrence distribution of 19%, or 49 occurrences, with specific deficits within the ISMS core function *provide feedback and continuous improvement*. Some of the occurrences in this category resulted because of the presence of legacy contamination, and, in some cases, the failure to properly anticipate, identify, or report legacy contamination during precursor activities to decommissioning, such as those typically conducted during deactivation.

This brings to the forefront the ostensible need to better distinguish the various D&D stages and activities not only for reporting purposes, but in actual planning activities associated with D&D work (e.g., deactivation as separate from and arising before decommissioning). This is crucial so managers and planners can better identify potential ES&H vulnerabilities associated with the conditions of facilities, its hazards inventory, and the work activities during different phases of D&D work.

Within this core function are the communication mechanisms that provide line managers confirmation that D&D work is either being performed safely or not and that hazard control choices are either working or not. At this juncture in the ISMS process, additional areas for improvement can still be identified and implemented. Feedback and data for these purposes typically originate from performance indicators, occurrence reports, trending analyses, self and independent assessments, and input from the workers, customers, suppliers, regulators, and stakeholders.

Feedback deficits were much more prevalent in what appeared to be deactivation-related occurrences with the majority involving insignificant class 4 legacy contamination events, although neither database (ORPS or OEWS) contained an activity category of "deactivation" that allowed for verification that this phase of D&D was being conducted during the occurrence. Interestingly, a review of these occurrences revealed that most legacy contamination occurrences were discovered as part of sound facility characterization, sampling, and surveying activities in support of D&D with no resulting adverse ES&H impacts. However, the fact that contamination was often found in areas designated as "clean," indicates a possible contamination control problem too, a "red flag" that releases were either not properly reported and controlled or contaminated areas were not properly cleaned up and monitored after corrective actions were taken. This again may indicate a need for managers to plan and monitor their D&D activities as separate and discrete phases in order to avoid surprises such as legacy contamination that in reality becomes an uncharacterized and unidentified hazard. In other words, hazardous materials removal, such as radiological materials on walls, duct work, and piping should be removed before decommissioning work begins. In some instances, some occurrences had associated with them decommissioning work in the presence of such legacy contamination that should and could have already been removed or cleaned up (e.g., occurrence # 58).

In general, legacy contamination is the result of less-than-optimal past practices that have allowed the release and spread of contamination. As more facilities become scheduled for D&D or are labeled as surplus, the greater the likelihood of legacy contamination persisting, minimally, as a feedback problem.

Identifying the conditions for the presence of legacy contamination, as well as the contamination itself, is important in establishing, prioritizing, and planning the proper D&D work to be conducted within the facility. Further, safety features and controls can be implemented before D&D work begins. Failure to conduct these facility conditions assessments and surveys or failing to provide and consider the resulting information in the D&D work planning process as part of the feedback mechanism may expose D&D workers and the environment to additional hazards including legacy contamination (e.g., occurrence #s 8, 45, 46, and 58).

Fifteen percent of the analyzed occurrences had ES&H deficiencies within the ISMS core function *analyze hazards*. Of this 15%, about half involved radiological exposures or contamination with one

third resulting in relatively significant worker skin or internal uptake impacts. The remaining half was evenly distributed between chemical exposures and contamination and physical impacts.

Occurrences with chemical exposures and contamination impacts ranged from very significant to relatively significant (class 1 and 2). They included internal chemical uptakes, an explosion and skin contamination with sulphuric acid, as well as other less severe worker exposure and contamination or environmental contamination.

Occurrences involving physical impacts were mostly near misses for blunt force trauma. Two occurrences were recorded for a very significant head/neck injury and one involved a class 3 puncture wound.

Within this core function, the analysis process revealed that an overwhelming number of these occurrences were associated with poor hazard identification, particularly as they related to instances when residual or unknown radiological hazards were still present in abandoned lines, piping, exhaust ducts, and equipment.

These results are not surprising given the overall nature of D&D work, which comprises for the most part tearing down old, contaminated structures and facilities that have physically degraded. Clearly, the potential for injuries, exposures, falls, etc. can rise during the removal and cleaning of plant systems, equipment, and piping that contain combinations of radiological and chemical materials and substances whose integrity and composition may have altered over time.

ES&H deficiencies within the ISMS core function *define the scope of work* accounted for about 11% of the occurrences. However, of that 11%, almost half had relatively insignificant ES&H impacts to workers and the environment, with a fifth having no significant impact. These occurrences were primarily related to minor radiological clothing contamination when tasks were poorly defined or the equipment used was inappropriate. Ensuing consequences included worker contamination and physical hazards involving near misses for or actual incidents such as mild electric shocks, blunt force traumas from having been struck by equipment, and cuts and puncture wounds.

In **Figure 3**, four of the ISMS core functions were further subcategorized (according to ISMS core function definitions) to identify more specific ES&H deficiencies arising within each function. The ISMS core function *defining the scope of work* was not subdivided in this study because the specific subcategories for this function were not easily assessable with respect to occurrence descriptions.

Of the 39 occurrences associated with the ISMS core function *analyzing hazards*, 30 resulted from deficiencies in hazard identification, and 9 were associated with inadequacies or failures to fully analyze the identified hazards. Poor hazard identification was usually associated with not properly or thoroughly investigating the conditions of the facility or work site as these activities relate to the defined work scope, which in one occurrence involved the improper storage of a mislabeled 5-gallon bottle containing radiological material.

Within the ISMS core function *develop and implement controls*, of the 80 occurrences, 60 were attributed to some deficiency related with inadequate work or hazards control practices. This means that although hazards may have been identified, even analyzed, because of inadequate postings, inappropriate PPE, or poor worker and management practices, workers were exposed or suffered some other S&H consequence (e.g., occurrence #s 11, 21, 24, 47, and 114). Of the remainder, 14 were related to deficiencies in written procedures and 6 occurrences had causative associations with training deficiencies.

Within the ISMS core function *perform work within controls*, of the 62 occurrences, over half, 36 occurrences, had causative links to failures in following procedures. These included workers entering confined space areas without a permit and workers knowingly using equipment improperly (e.g., using a pressure washer to clean a face shield). Of the remainder, 14 occurrences resulted from equipment failure; 10 were due to human error, and 2 resulted from inadequate change control practices.

Within the ISMS core function *provide feedback*

and continuous improvement, of the 49 occurrences identified for this function, 45 had causative links to the existence of legacy contamination, hazards that were present due to past operations. The presence of legacy contamination is, according to the ORPS criteria, a condition for reporting an occurrence.

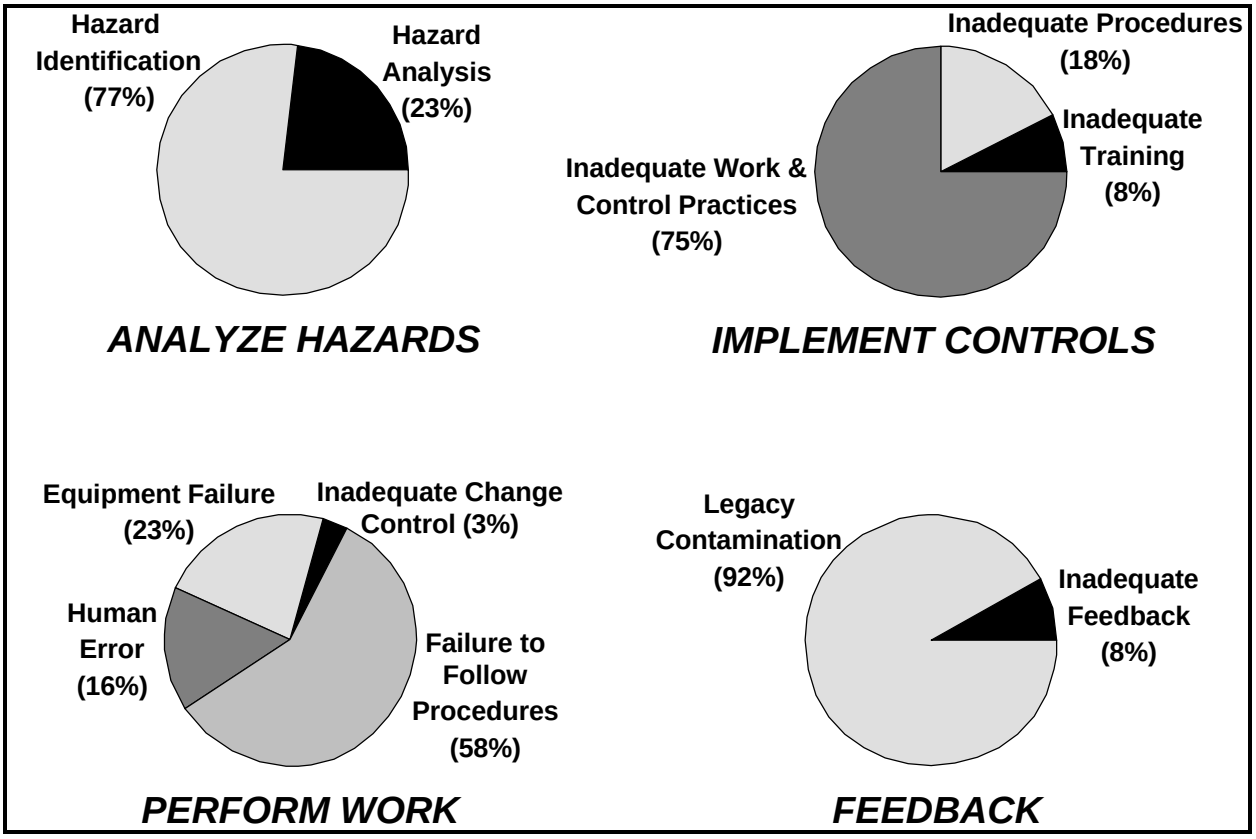

Figure 3 - Specific ES&H Deficiencies by ISMS Core Function

It does not indicate that management or worker deficiencies existed as part of the work performed during that phase of the facility's life-cycle. Only 4 occurrences were attributed to feedback problems that did not involve legacy contamination.

3.2 Types of Hazards

Figure 4 illustrates the distribution of **hazard types** encountered during the performance of D&D activities described in the occurrences. In **Figure 4**, 168 occurrences involved radiological hazards, 37 involved chemical hazards, 24 involved physical exposure hazards (e.g., fires, burns, and electric shock), 20 involved physical trauma hazards (e.g., punctures, cuts, or blunt force impacts), and one occurrence involved a biological/viral hazard. Seventeen occurrences had no associated hazard exposure. These events typically involved reporting or documentation violations without the presence of a hazard or hazardous condition.

3.3 ES&H Consequences by Hazard Type

Occurrences were also examined for specific **ES&H consequences** that may have resulted from one or more of the **hazard types** identified. The four pie charts in **Figure 5** provide distributions of specific ES&H consequences by hazard types within the occurrences. For the 168 occurrences involving radiological hazards, 172 radiological-related ES&H consequences were identified (some occurrences have multiple consequences). These consequences were distributed relatively evenly (about one third each)

between personnel external/skin contamination, environmental contamination, and near misses for personnel or environmental radiological exposure and contamination.

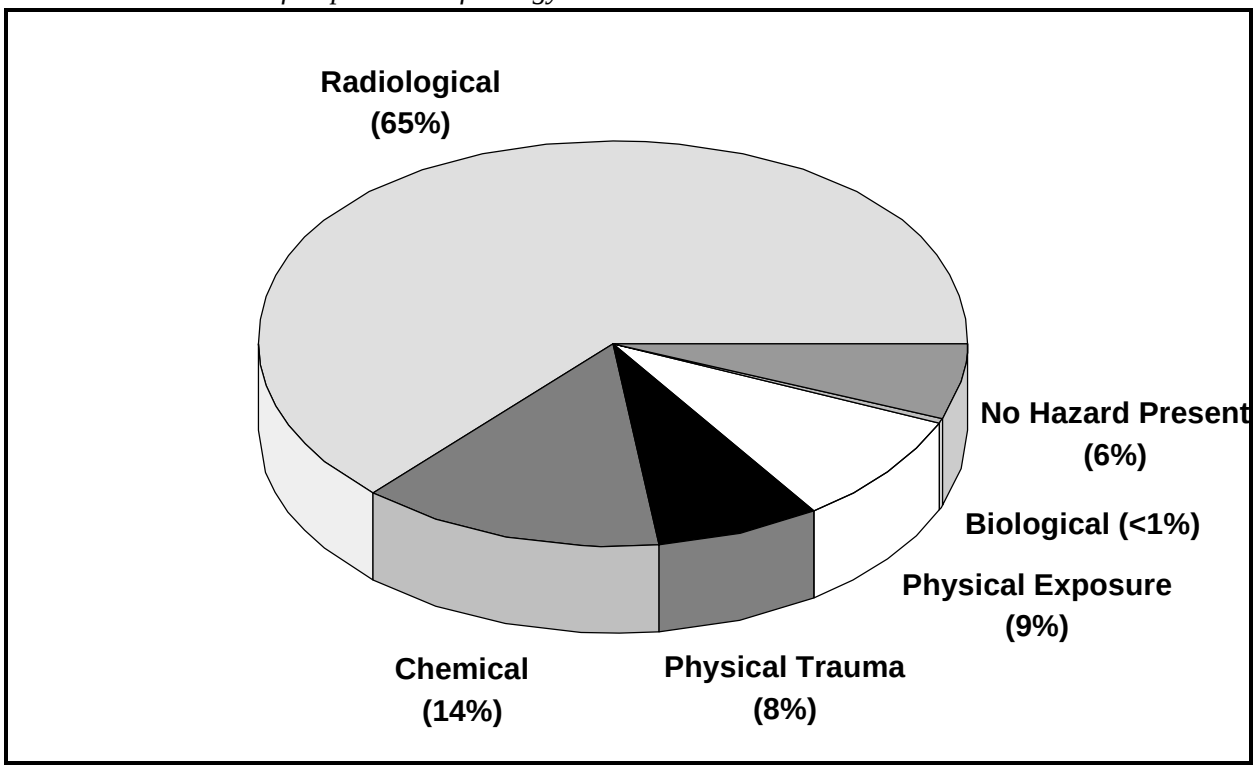

Figure 4 - Hazard Types

Within the 37 occurrences involving chemical hazards, 39 chemical-related ES&H consequences were identified. Almost half resulted in environmental contamination or exposure. Over one

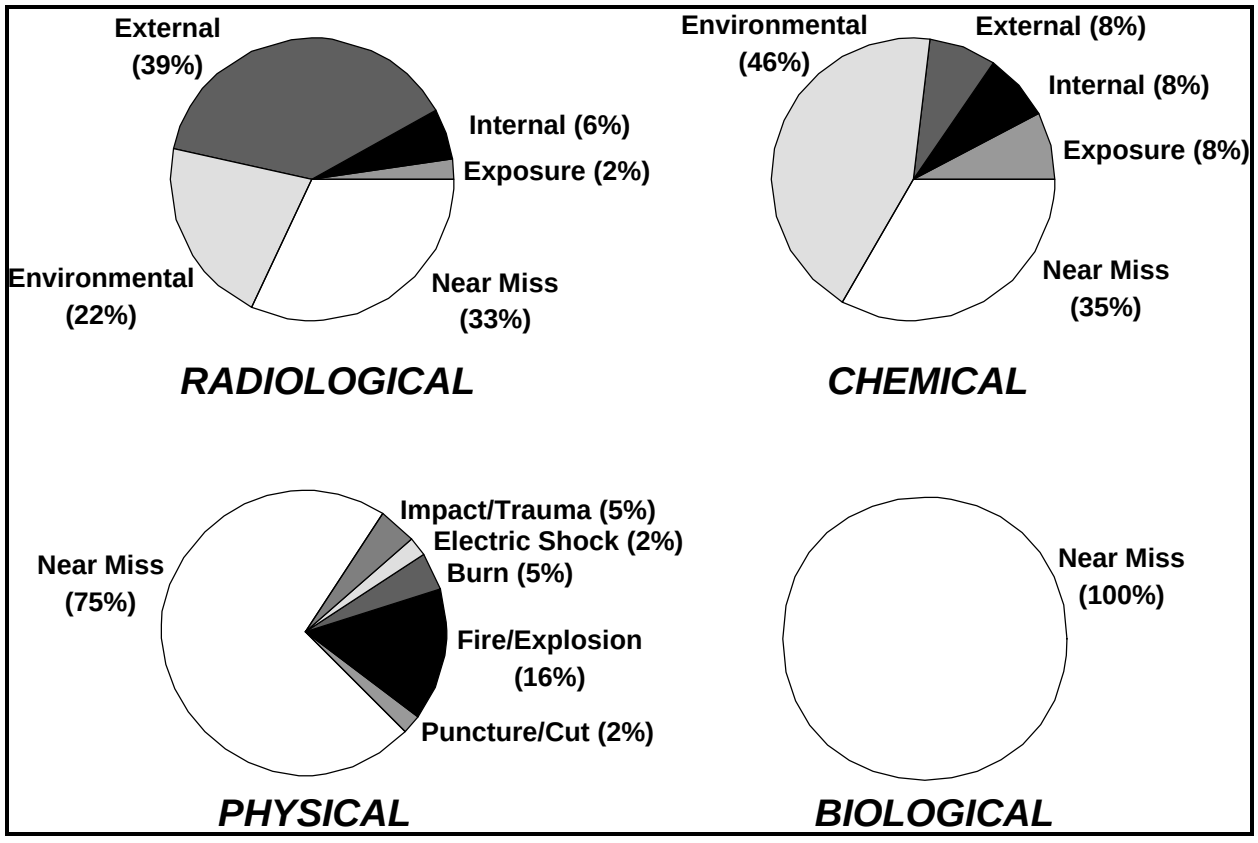

Figure 5 - ES&H Consequences by Hazard Type

third were near misses for personnel exposure or contamination or environmental contamination.

Within the 44 occurrences involving physical hazards, 46 physical-related ES&H consequences were identified. Most, 33 occurrences, were near misses for injuries due to blunt force trauma/impact. Of the remainder, 7 involved a fire or explosion, 2 involved impact or trauma to workers from machinery or equipment, 2 involved burns, 1 involved workers getting punctured or cut, and 1 involved electric shock.

Only 1 occurrence was associated with a biological/viral hazard, which was a near miss from the discovery of radioactive mouse droppings.

3.4 Significance Ranking

As described in Section 2, a 4-class classification scheme was applied to each occurrence within each hazard category in order to better understand the significance of the proportions illustrated in the pie charts in **Figures 4 and 5**. Although 65% of the sampled occurrences had radiological hazards associated with them, they also had different ES&H consequences and degrees of severity associated with these consequences, as functions of how the hazard impacted workers and the environment.

In order to better understand the relative importance of these impacts, the classification scheme was applied to provide significance ranking for the occurrences. **Figure 6** provides a pie chart for each hazard category with a breakout of occurrences by their significance, as defined by the classification scheme.

Radiological Hazards

For occurrences with radiological hazards identified, about one fifth, or 36 of the ES&H consequences associated with these occurrences, were identified as insignificant, class 4 incidents. These class 4 occurrences typically involved either minor or near misses for releases, leaks, spills or containable legacy contamination that produced no adverse worker or environmental impacts (e.g., occurrence #s 128 and 131). The next level of significance, class 3, was assigned to 89 of the 172 radiological-related consequences, with a more or less even distribution between: clothing contamination (usually personal protective equipment), the identified barrier remaining before actual external (skin) or internal worker contamination happens; environmental contamination incidents that were considered precursor conditions for a class 2 occurrence; and near misses (e.g., occurrence #s 144, 129, 133, and 136).

The majority of the class 2 radiological-related ES&H consequences, 39 occurrences, involved worker skin contamination (e.g., occurrence #s 134 and 168). The highest level of concern or significance, a class 1, was assigned to 8 radiological-related ES&H consequences because they involved internal radiological exposures to workers requiring medical attention via bioassays (e.g., occurrence # 156).

Chemical Hazards

For occurrences involving chemical hazards, 44%, or 17 occurrences, were ranked as class 3 with most involving a near miss (e.g., occurrence #s 10 and 21), followed by chemical environmental contamination, (e.g., occurrence # 42) and 2 occurrences involving clothing contamination (e.g., occurrence # 88).

Thirty-one percent of the chemical-related ES&H consequences were ranked as least significant, a class 4, because they involved inconsequential chemical spills or leaks or near misses of such (e.g., occurrence #s 1, 95, 198, and 246). Six, or 15% of all chemical-related consequences, were given a more significant class 2 ranking because of worker skin contamination or a non life-threatening internal exposure (e.g., occurrence # 33) or, again, a spill or leak that was not contained immediately or that migrated off-site.

An important analysis observation was the higher number of chemical-related occurrences, proportionally speaking, over radiological occurrences, that had a class 1 ranking (e.g., occurrence # 17). Four of 39 occurrences, or 10%, were identified as class 1. This observed condition may be a function of D&D work that will often require contact with unknown types and quantities of chemicals that have remained interred either in piping, drums, etc. for some extended and unmonitored period of time. Left unattended and virtually unmanaged, these chemical stores may have, as previously mentioned, changed composition or may have mixed with other chemicals or climatic or physical elements, potentially increasing their

hazardous nature.

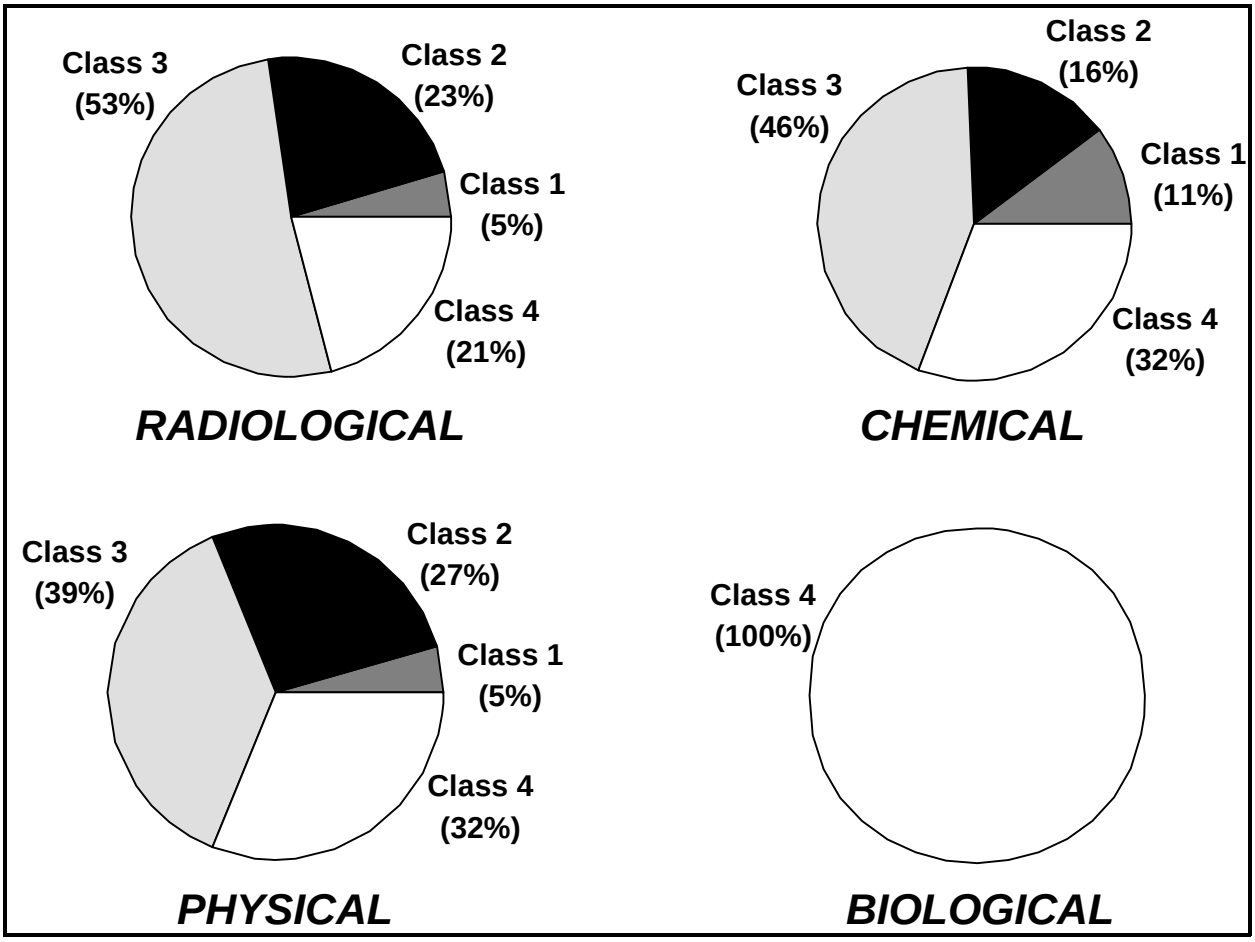

Figure 6 - Significance Ranking by Class

Indeed, as a result of this unique D&D condition, unmonitored or unattended chemical materials in one occurrence resulted in an explosion (e.g., occurrence # 12).

OSHA-Type Physical Hazards

Within the 44 occurrences involving physical hazards, 45 physical-related ES&H consequences were noted. These were distributed almost evenly between classes 2, 3, and 4, as near misses and electric shock, punctures or cuts, and minor blunt-force trauma (e.g., occurrence #s 18, 32, and 34). Two occurrences, or 5% of this set, were ranked as class 1 because of the severity of the ES&H impact, namely, a physical blow to a worker from equipment and a puncture wound, both requiring medical attention (e.g., occurrence #s 137 and 120).

3.4.1 Summary of Significance Ranking

Hazard Control

Overall, in terms of the significance of impacts to workers and the environment, what the analyzed sample revealed, as illustrated in **Figure 6**, is that about three-quarters of the D&D occurrences were class 2 and 3 events initiated primarily from deficiencies in the ISMS core function associated with hazard control.

When deficits occur during hazard control, the possibility of relatively significant occurrences involving radiological and chemical exposure or contamination could increase. As the analysis demonstrates, even though these were mostly clothing and minor skin contamination incidents, perhaps their preponderance indicates a potential for the existence of a chronic problem during D&D. ***Existence of Radiological and Chemical Source Terms***

D&D activities present unusual and often unique conditions including distinctive work techniques to remove often coexisting radioactive and chemical

contamination from equipment, piping, and other systems and demolition and deconstruction of structures and systems that may not only be contaminated but also structurally unsound.

3.4.2 Distribution of Hazards by Significance Ranking

Figure 7 illustrates the distribution of hazards within each of the 4 classes. These proportions are based on the information contained in **Tables A3-A5** in Appendix A. Again, although radiological hazards dominate all four classes, the relative proportions are important to consider for an appropriate perspective. Within the 14 total class 1 occurrences, 8 involved internal uptakes by workers through inhalation or ingestion. Two of the 4 chemical class 1 occurrences also involved internal uptakes. Within the 57 class 2 occurrences, of the 39 occurrences with radiological hazards, 34 involved minor clothing or skin contamination events.

Human Factors

Of interest is the number of near misses for physical hazards: 8 out of 14 occurrences, with 6 of these occurrences resulting in near miss incidents of electric shock, slip, trips, falls, or blunt force trauma because of deficiencies in the ISMS core function involving *perform work*.

Many of these deficiencies may have been preventable as has been suggested by experts in the field of human factors, because to identify human failings as causes for accidents strictly is not only often untrue, but unhelpful. Constructive action must include optimizing work performance through better design, but even more importantly through better training or instruction, and better auditing or inspection.

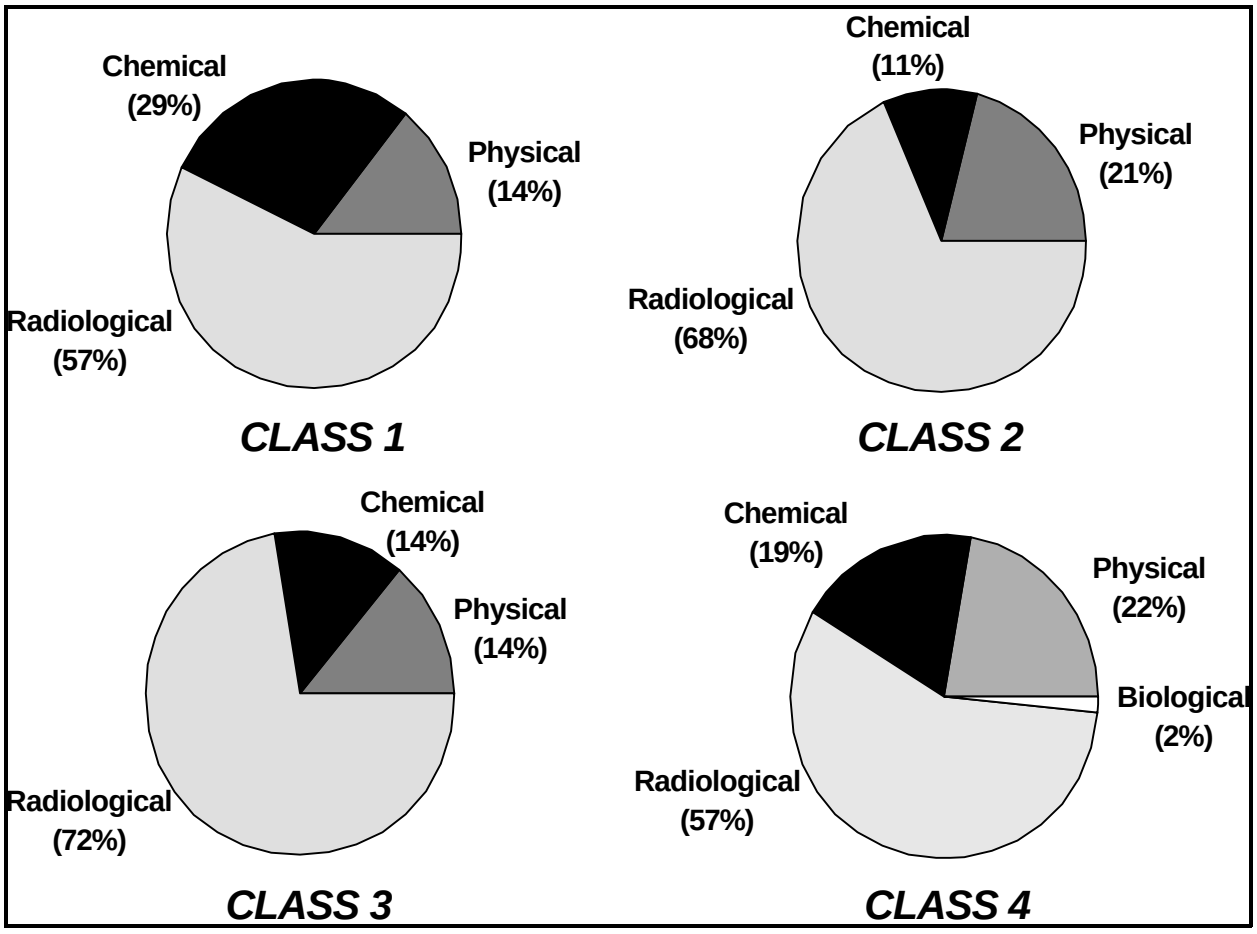

Figure 7 - Distribution of Hazards by Significance Ranking

Radiological Hazards

The most frequently occurring class rank throughout the sample was class 3 with a total of about 123 occurrences with 89 of these having radiological hazards identified as the primary hazard. All but 4 of these 89 were related to minor clothing or skin contamination, minor environmental contamination, or near misses for these two categories. These findings once again support previous assertions that a possible trend exists within D&D activities for these types of events involving relatively insignificant but chronic radiological hazards related to exposures and contamination. In addition, as illustrated in **Table A6** in Appendix A, most of these class 3 radiological hazards resulted from deficits in the ISMS core function involving *hazards control*.

Class 4 occurrences accounted for 36 out of 62 occurrences that involved near misses for an unspecified radiological exposure (occurrence descriptions were insufficient to determine more specificity). The distribution for these occurrences in terms of deficiencies was relatively even between the core functions of *feedback* (i.e., legacy contamination), *hazard identification*, *hazard control* (primarily inadequate work practices), and *perform work* (primarily failure to follow procedures).

Once again, these distributions and the deficiencies attributed to them support the possibility of a chronic problem related to radiological exposures because of inadequacies primarily in hazards identification activities if legacy contamination goes undetected during D&D activities such as decommissioning.

Legacy Contamination

4.0 CONCLUSIONS AND RECOMMENDATIONS

Overall, the sample of D&D occurrences analyzed did not indicate an excess of highly significant (class 1) or highly severe ES&H impacts to workers and the environment, with the exception of the 2 fatalities. However, what this analysis has identified are distributions of occurrences within specific areas of D&D work that have specific safety management deficits, as defined by the ISMS; the types of hazards encountered; and the nature of the frequency of particular ES&H impacts that indicate the potential for trends. If these proportions are indicative of trends and if they persist, enormous opportunities exist for D&D managers and ES&H experts to dedicate more focused attention and resources within these areas to prevent or mitigate these trends as D&D activities increase.

Broadly, this analysis can help identify the different perspectives that D&D managers may want to consider when attempting to design and implement their safety and health management systems for D&D work. If certain vulnerabilities, potential for vulnerabilities, hazards, and impacts are known to exist within particular D&D activity phases, such as legacy contamination during deactivation or the potential for more severe chemical exposures during decommissioning, managers can plan accordingly and bolster elements of their ISMS as necessary.

The review and analysis of the sample of D&D occurrences provides a possible historical bases for the insights and recommendations contained in this section and which are based on the results described in Section 3.0. Also several guidance documents, and lessons learned reports, and other documentation are readily available to provide further detail in order to help enhance the application of ISMS core functions to D&D work, including DOE standard DOE-STD-1120-98, *Integration of Environment, Safety and Health into Facility Disposition Activities*.

4.1 Specific D&D-Related Recommendations

D&D activities have associated with them many unique conditions and circumstances that can increase ES&H risks. These include: dynamic work environments; increased work activities that involve handling, packaging and removing hazardous wastes; an increase in the presence of radiological, chemical and physical hazards; an often itinerant work force; the potential for exposure to unknown hazards and unknown quantities and inventories of hazards; synergistic ES&H effects from the presence of or exposure to several hazard types (e.g., asbestos removal in confined spaces; deconstruction activities around uncharacterized areas that may still contain buried, live electrical conduits; encountering stored, unlabeled chemical or other materials; etc.). Because of these conditions and circumstances, all of which were encountered or identified within the reviewed occurrences, the following specific recommendations are offered:

- conduct a graded approach to task-based hazard analysis because D&D work (especially deactivation) can often involve many, one-time, non-repetitive work tasks which vary in complexity and in the type of hazards that may be encountered, and also tasks can change suddenly or may need to be modified given the uncertainties typical of D&D work (e.g., the discovery of active, electrical conduits during deconstruction, or demolition);
- ensure the appropriateness and comprehensiveness of hazards identification and control practices to help eliminate the potential for chronic, low-level radiological (e.g., clothing, shoe, PPE contaminations) or in particular mor insidious chemical exposures that may ensue in significant ES&H impacts;
- ensure the appropriateness and comprehensiveness of hazards identification and control practices to help anticipate and prepare for instances wherein workers must potentially deal with several different types of hazards at once. (e.g., the presence of radiological contamination within areas where pipe-cutting may be going on for example and pipes and other systems may still contain undetermined types and quantities of chemical hazards);
- identify and document and control new hazards that emerge or have gone undetected especially when transitioning from one D&D phase to another (e.g., the oversight of identifying and controlling legacy contamination prior to

decommissioning activities);

- be prepared to identify and apply alternative requirements to safety management requirements (contained in orders applicable to nuclear safety) that are more appropriate to activities and settings that involve low-level, residual, fixed radioactivity, typical during decommissioning;
- ensure that worker safety and hazard controls are well thought out and justified and appropriate such that worker exposures due to profuse sweating through PPE can be eliminated, that ventilation fans do not contribute to hazardous materials migration, that contaminated equipment and contaminants are not sent off-site or outside a controlled area;
- uncertainties in materials inventories, hazards inventories need to be properly reflected in or anticipated by the appropriate safety controls particularly when work packages and scopes change, hazardous conditions change (e.g., the discovery of dispersible hazardous materials during the course of work will require new controls);
- performing systematic readiness reviews to identify ES&H needs during work transition phases so that issues like legacy contamination are satisfactorily dealt with; when workers/contractors are changed/rotated to ensure workers have been properly briefed, trained, etc.; so that typical D&D-type changes to work scopes or job and tasks are always communicated;
- Feedback and communication systems and mechanisms are strong, efficacious and reliable in order to handle the dynamic D&D setting.

4.2 General Recommendations

While many of the following additional recommendations are applicable as general good practices for all types of work activities, they have application also for D&D work, and so are worth re-iterating.

Because a full third of the sampled occurrences resulted from deficiencies within the ISMS core function *develop and implement controls*, managers can potentially improve the execution of this core function during D&D by:

- Considering the type of work being performed, other work activities being performed nearby, the physical conditions of the work (e.g., crawling on knees, the potential for profuse sweating while wearing PPE, etc.),
- Considering the work environmental conditions,
- Ensuring the proper worker supervision and training so that work practices and procedures are followed,
- Engineering hazards out of chosen work methods or selecting alternative, less hazardous, work methods,
- Establishing limits and checks based on inventories to prevent unauthorized hazardous materials from entering a given facility area or migration of these materials outside controlled areas,
- Providing air monitoring to maintain adequate airborne hazards control,
- Using proper PPE,
- Using administrative controls that limit some activities with adequate postings and lock-out/tag-out,
- Ensuring training satisfies requirements and qualifies workers for specific tasks and jobs,
- Using sound hazard baseline documentation and work packages.
- Ensuring that procedures are adequate and that workers follow any controls identified,.

Because a significant number of occurrences had identified deficits within the ISMS core function *perform work*, procedural vulnerabilities in particular can be reduced by:

- Reviewing other D&D lessons learned from departmental and private sector sources such as:
  - **S** DOE/EH-0486, *Integrating Safety*

and Health During Deactivation with Lessons Learned from PUREX;

- DOE/EH-0546, *Integrating Safety and Health During Decommissioning with Lessons Learned from INEL*;
- DOE/EH-0566, *Worker Involvement Lessons Learned and Good Practices from INEEL Facility Disposition Activities*; and
- DOE/EH-0568, *Cost-Effective Facility Disposition Planning with Safety and Health Lessons Learned and Good Practices from the Oak Ridge Decontamination and Decommissioning Program*

- Providing proper training to understand and follow procedures and recognize and report hazards,
- Ensuring procedures and equipment are adequate for the work type,
- Ensuring all relevant procedures, equipment operations procedures, postings, appropriate PPE, etc. are reviewed and understood throughout work planning and execution,
- Performing work within and implementing and maintaining appropriate hazard controls, and
- Assuming contamination may exist.

Nineteen percent of the sample had problems identified within the core function *provide feedback and continuous improvement*. D&D managers should give consideration to feedback during D&D work by:

- Assuming legacy contamination exists even within"clean areas," especially if the facility has been shutdown for many years or has been "abandoned in place,"
- Involving workers in the development, field testing, and walkthroughs of procedures prior to their full implementation, and
- Providing a worker and project feedback mechanism for reporting changed work conditions, legacy contamination, and vulnerabilities.

Fifteen percent of occurrences had deficits within the core function *analyze hazards*. D&D managers can significantly improve their hazards profile before work begins by:

- Reviewing facility operation records and existing hazard baseline documentation, particularly for the presence of legacy contamination or other unknown sources and quantities of hazards,
- Updating all performed or existing analyses,
- Interviewing former and current employees to supplement historical operations or other information,
- Performing detailed facility walkdowns using a multi-disciplinary team to identify and assess often existing residual, unknown, or legacy contamination and hazardous conditions,
- Identifying and documenting the hazards associated with the planned work,
- Assigning clear roles and responsibilities for the conduct of hazards analyses,
- Performing both facility and task level hazards analyses, and
- Ensuring the above information is made available to all personnel involved with D&D work planning and execution.

Eleven percent of the sampled occurrences had deficits identified within the core function *define the scope of work*. D&D managers can improve their D&D project planning and definition by:

- Prioritizing and defining project tasks and activities,
- Negotiating and describing work scopes in detail so that, for example, deactivation-type activities are conducted prior to performing decommissioning activities,
- Developing work plans that include thorough hazard identification, characterization, analysis, and control strategies as a means to reduce chronic hazards exposures and identify legacy contamination,

- Establishing performance objectives, expectations, progress metrics measures, and incentives,
- Defining organizational responsibilities,
- Identifying resource needs,
- Selecting and utilizing qualified workers,
- Evaluating subcontractor ES&H programs for respiratory protection, training, hazardous material control programs, confined spaces, etc.,
- Ensuring DOE and CERCLA requirements are identified and integrated into the project plans,
- Establishing appropriate and realistic schedules, and
- Ensuring hazards identification and characterization activities are sound and properly executed.

4.3 Observations Regarding ORPS as a Data Source

Having used the ORPS database as the primary and central source for data collection in the form of departmentally-accepted occurrence descriptions, several observations and recommendations are offered below.

The ORPS database system categorizes the occurrences into twelve different categories. However, approximately 9% of the events identified as Facility Decontamination and Decommissioning were not related to this category, but instead to decontamination of equipment as part of another activity category (e.g., normal operations). Accurate or more specific and representative categorization of activities is crucial for determining trends, in addition to the types of occurrences and hazards associated with a specific type of activity.

- Field determination of the activity category as it relates to an occurrence needs to be straightforward enough to enable accurate tracking and trending.

The current ORPS categorization only identifies Facility Decontamination and Decommissioning. Facility disposition comprises several other activities and phases, including deactivation and long-term surveillance and maintenance (S&M).

- It may be worthwhile to expand ORPS to include a separate category to capture the unique hazards and facility conditions associated with facility deactivation and S&M and other distinct subcategories of facility disposition.

The discovering of legacy contamination in-and-of-itself is basis enough for a reportable occurrence within ORPS, even when the work was conducted safely with the expressed purpose of finding legacy contamination.

- It may be worth establishing a mechanism for identifying the discovery of legacy contamination outside of the ORPS system or through the lessons learned mechanisms or retailoring the reporting system to capture and identify instances of legacy contamination that arose because of ES&H deficiencies.

APPENDIX A
EVALUATION OF RANDOMLY SELECTED D&D OCCURRENCES

APPENDIX A - EVALUATION OF RANDOMLY SELECTED D&D OCCURRENCES

Appendix A provides a spreadsheet of analytical results for the 341 D&D occurrences that were analyzed. In addition, Appendix A provides in chart form definitions and descriptions of the analysis categories that were not defined in either the glossary or the Approach/Methodology section of the report.

Clarification and definitions for acronyms and terms used to describe and quantify analysis results for the sampled occurrences are provided below.

Occurrence Description

This category provides a brief description of the actual occurrence event. The analysis was focused on identifying the information related to the events that actually occurred during the facility disposition activities.

Work Type

Major types of facility disposition activities and associated work activities are discussed in Section 2 and defined in the Glossary. Acronyms used to describe activities in Appendix A are as follows:

CHAR - Characterization

SAMP - Sampling

DEAC - Deactivation

DECM - Decommissioning

DECN - Decontamination

DISM - Dismantlement

DEMO - Demolition

ES&H Deficiencies

ES&H deficiencies are described according to the five core functions of integrated safety management (defined in Section 2). Acronyms and definitions for specific ES&H deficiency categories are defined in **Table A1**.

Hazards and ES&H Consequences

Hazard categories, as described in Section 2, and associated consequences are shown using the acronyms/descriptions provided in **Table A2**.

Significance Ranking

Based on the information provided within the occurrence reports, each occurrence is ranked/classified. **Tables A3 through A6** provide a breakdown of significance rankings for each of the hazard types and ES&H consequence categories.

Occurrence Analysis Results

The D&D-related occurrences analysis results are presented in **Table A7**. The table contains in column form:

1. a description of the occurrence;
2. the type of work being conducted;
3. the ES&H deficiency that contributed to or caused the occurrence;
4. the type of hazard involved;
5. the resulting consequence;
6. the date of the occurrence and
7. the title and date of the occurrence.

DW	**Define Work Scope**	**Discussed in Section 2**
AH	**Analysis of Hazards**	**Discussed in Section 2**
HI	Hazard Identification	The complete set of hazards associated with the defined work scope are not adequately identified and thus not analyzed, potentially subjecting workers to unknown conditions and hazards or causing the release or spread of contamination to the environment.
HA	Hazard Analysis	The identified hazards are not adequately analyzed and thus proper controls are not identified for these hazardous conditions.
HC	**Develop and Implement Controls**	**Discussed in Section 2**
IWK/CON	Inadequate work or hazards control practices	The work or hazards control practices do not protect the workers or environment from exposure to the identified and analyzed hazards (e.g., inadequate postings, inappropriate PPE, poor worker or management practices).
PRO	Inadequate Procedures	Procedures, policies, work permit, or work instructions are not adequate to ensure protection of workers
T	Inadequate Training	Workers are not trained in accordance with work procedures or training that is provided is does not adequately address the hazards encountered during work activity
PW	**Performance of Work**	**Discussed in Section 2**
CC	Inadequate Change Control System	Failure to modify procedures or training to reflect changes in work methods or hazards, thereby resulting in avoidable violations, exposures, and incidents.
EF	Equipment Failure	Equipment fails to perform its intended function.
HE	Human Error	Worker actions that are unplanned and inconsistent with accepted and prescribed work procedures leading to violations, exposures, and incidents.
PRO	Failure to Follow a Procedure	The failure of the workers to actually follow an adequate procedure, policy, and permit.
FB	**Provide Feedback and Continuous Improvement**	**Discussed in Section 2**
LC	Legacy Contamination	Contamination that is discovered or reported during facility disposition (typically during characterization or remediation), but actually occurred during a previous facility phase.

Table A1 - Definitions of Specific ES&H Deficiency Categories

RAD - Radiological Hazards		
RE	Radiological Exposure	General category used when ORPS data not specific on exposure type
RIC	Internal/Inhalation-Ingestion	Inhalation or ingestion of radioactive particulates
RSC	External/Skin	Radiological material contact with clothing or exposed skin
REC	Environmental Contamination	Contamination of environment with radiological material
CHM - Chemical Hazards		
CE	Chemical Exposure	General category used when ORPS data not specific on exposure type
CIC	Internal/Inhalation-Ingestion	Inhalation or ingestion of hazardous chemicals
CSC	External/Skin	Skin or clothing contact with hazardous chemicals
CEC	Chemical Contamination	Contamination of environment with hazardous chemicals
PHT - Physical Trauma Hazards		
IT	Impact/Trauma	Impact from workers hitting or being hit by object
PC	Puncture/Cut	Cuts or puncture wounds
STF	Slip/Trip/Fall	Slip, trip or fall due to unstable surface or other external force
PHE - Physical Exposure Hazards		
BN	Burn	Burns received from fire, explosion
FE	Fire/Explosion	A fire/explosion which does not affect a worker
ES	Electric Shock	Electrocution or shock from inadvertent contact with electricity
APH	Asphyxiation	Asphyxiation from physical or chemical agents
BIO - Biological Hazards		
B	Biological exposure/contamination	Injury or illness received from biological agent (e.g., snakes, insects, contaminated rodent droppings)

Table A2 - Specific Hazard Categories and Associated ES&H Consequences

	Class 1	Class 2	Class 3	Class 4	**Total**
RE			4		**4**
RIC	8	2			**10**
RSC		34	32		**66**
REC			27	10	**37**
NM		3	26	26	**55**
TOTAL	**8**	**39**	**89**	**36**	**172**

Table A3 - Significance Ranking Distribution for Radiological Hazards

	Class 1	Class 2	Class 3	Class 4	**Total**
CE		1	1	1	**3**
CIC	2	1			**3**
CSC	1		2		**3**
CEC	1	3	5	8	**17**
NM		1	9	3	**13**
TOTAL	**4**	**6**	**17**	**12**	**39**

Table A4 - Significance Ranking Distribution for Chemical Hazards

	Class 1	Class 2	Class 3	Class 4	**Total**
IT	1	1			**2**
PC		1			**1**
STF					**0**
BN		2			**2**
FE	1	1	3	1	**6**
ES		1			**1**
APH					**0**
NM		6	14	13	**33**
TOTAL	**2**	**12**	**17**	**14**	**45**

Table A5 - Significance Ranking Distribution for Physical Hazards

	Class 1	Class 2	Class 3	Class 4	No ES&H Consequences	**Total**
DW	1.5	2.5	14	5	4	**27**
AH	5	10	12.5	8.5	2	**38**
HC	2.5	26.5	34	15	2	**80**
PW	1	12	27.5	17.5	4	**62**
FB		1	8	34	7	**50**
TOTAL	**10**	**52**	**96**	**80**	**19**	**257**

Table A6 - Significance Ranking Distribution for ES&H Consequence Categories

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
1	Hydraulic oil leaked from an excavator after mechanic removed damage hose and plugged the port with a rag and did not tag the equipment as out of service. Leak was observed from the excavator after the weekend	DECM - Removal of damaged hose at facility decommissioning project	PW (PRO)	CHM	CEC	4	25-Aug-97	ID--LITC-TRA-1997-0018 Hydraulic oil spill
2	Cable and telephone line severed by a back-hoe during excavation work at a deactivation facility	DEAC - Backhoe performing excavation work at deactivation facility	HC (T)	PHE	NM (ES)	3	07-Aug-97	RL--PHMC-WESF-1997-0007 Abandoned communications line severed during back-hoe operations
3	Deteriorated natural gas line broken during its excavation.	DECM (DEMO) - Natural gas line removal / disconnection in preparation for bldg demolition	PW (EF)	CHM / PHE	CE / NM (FE)	4/3	14-Jul-97	HQ--GOPE-NIPER-1997-0002 Natural gas line separation during excavation outside of building 6
4	Contamination found on worker's left ear and full-face respirator	DECM - Performing decommissioning activities	HC (IWK/CON)	RAD	RSC (skin)	2	09-Jul-97	RFO--KHLL-PUFAB-1997-0062 While Performing Decommissioning Activities, Employee Receives Skin Contamination To Left Ear
5	Worker placed foot under robot to disconnect tether and contacted contamination on robot	DEAC - Underwater robot-assisted silt removal from fuel pool at Bldg 330	HC (PRO)	RAD	RSC (shoes)	3	27-Jun-97	CH-AA-ANLE-ANLEER-1997-0005 Personnel Contamination
6	Sampling crewman's forearm contaminated during sampling	DECM (SAMP) - Sampling of waste containers	HC (IWK/CON)	RAD	RSC (skin)	2	26-Jun-97	ORO--LMES-PGDPENVRES-1997-0006 (1) Personnel Skin Contamination
7	Sampling crewman's forearm contaminated during sampling	DECM (SAMP) - Sampling of waste containers	HC (IWK/CON)	RAD	RSC (skin)	2	16-Jul-97	ORO--LMES-PGDPENVRES-1997-0006 (2) Personnel Skin Contamination
8	Detection of unexpected airborne plutonium in an abandoned facility undergoing decommissioning.	DECM - Air sampling and rad surveying in preparation for airlock removal	FB (LC)	RAD	RE	3	24-Jun-97	RL--BHI-DND-1997-0018 Detection of Unexpected Airborne Plutonium
9	25 gallons of suspected diesel fuel and petroleum hydrocarbons spilled onto the ground	DECM - Lifting underground storage tank at Sigma Mesa for removal	DW	CHM	CEC	4	24-Jun-97	ALO-LA-LANL-PHYSTECH-1997-0005 Approximately 25 gallons of suspected diesel fuel and petroleum hydrocarbons spilled onto the ground
10	Mislabeling 5-gal bottle, containing Pu and chromium, found in storage on the 100N 90-day storage pad beyond the 90 day limit	DECM - Decommissioning activities at the facility	AH (HI)	RAD / CHM	NM (RE) / NM (CE)	4/3	4-Feb-97 through 19-Jun-97	RL--BHI-DND-1997-0016 Mixed Waste Mislabeled
11	Sump pump removed from high contamination area without being surveyed for contamination	DECM - Sump pump removal	HC (IWK/CON)	RAD	NM (RE)	4	27-May-97	OH-MB-EGGM-EGGMAT03-1997-0002 Transfer of pump out of High Contamination Area without Radiological Survey
12	Chemical explosion at an inactive facility waiting to be deactivated. Event occurred because hazard materials had not been periodically surveyed and analyzed.	DEAC - Inactive facility waiting for deactivation	AH (HI)	PHE / CHM	FE / CEC / CIC	1/1/1	14-May-97	RL--PHMC-PFP-1997-0023 An Explosion Occurred at the Plutonium Reclamation Facility resulting in an Emergency Response (OEWS)
13	Subcontractor entered a confined space work area w/o authorized permit	DECM (DECN) - Water tank refurbishment: grit blasting and repainting	PW (PRO)	PHE	NM (APH)	3	28-Apr-97	ID--LITC-TANLL-1997-0002 Confined Space Permit authorization violated
14	Hot slag lodged in folds of anti-cont. clothing during steel cutting and ignited pant leg of coveralls	DECM - 116-C-5 Retention Basin steel cutting operations	HC (IWK/CON)	PHE	BN (pants)	2	07-May-97	RL--BHI-REMACT-1997-0005 Cutting Operation Results in Anti-Contamination Clothing Fire
15	Ground contamination located in 291B area after moving a conex box	DEAC - Survey activities as part of transition activities to shutdown at B-Plant	FB (LC)	RAD	REC	4	01-May-97	RL--PHMC-BPLANT-1997-0008 Contamination Found Under Conex
16	Contamination found in backhoe bucket after backhoe was used to transport pipe supports and footings from a contaminated soil area	DECM - Backhoe used to transport pipe supports and footings from contaminated soil area	PW (PRO)	RAD	REC	3	28-Apr-97	ORO--MK-WSSRAP-1997-0004 Front bucket of backhoe discovered with contamination over reportable levels for exit from a controlled area during exit survey
17	Workers complained of nausea and having smelled "sweet sickening odor"	DEAC - Capacitor draining operations in Bldg 865	AH (HI)	CHM	CIC	1	31-Mar-97	RFO-KHLL-NONPUOPS1-1997-0006 Potential Concern; Capacitor Draining Operations - Bldg 865 - (OEWS)

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
18	Crane operator knowingly exited crane improperly when attempting to place hooks into lift points of equipment 20 ft. underwater	DECM - Crane operations	PW (PRO)	PHT	NM (STF)	3	18-Mar-97	RL--BHI-NREACTOR-1997-0005 Noncompliance with Fall Protection Requirements
19	During sediment characterization in a fuel basin, worker exposed to contaminated dust when plywood cover was lifted remotely and struck a wall	DEAC (CHAR) - Sediment characterization in a fuel basin	AH (HA)	RAD	RIC	1	29-Jan-97	RL--BHI-DND-1997-0009 Potential Unexpected Radiological Exposure
20	Container caught fire during spot welding of a plastic liner on a waste container	DECM - Spot welding of a plastic liner on a waste container	AH (HA)	PHE	FE	3	4-Mar-97	RL--BHI-REMACT-1997-0002 Waste Container Fire
21	Uncontained asbestos in waste material was improperly disposed of.	DECM - Disposal of waste material	HC (IWK/CON)	CHM	NM (CEC)	3	3-Feb-97	RL--BHI-REMACT-1997-0001 Inadvertent Shipment of Asbestos Containing Materials
22	Violations of Ohio Hazardous Waste Regulations - site cont. plan amendments; training; insp. sched. and procs	DECM - Decommissioning activities at the facilities	DW	None	None	None	2-Jan-97	OH-AB-RMI-RMIDP-1997-0003 Ohio EPA Notice of Violation for RCRA Inspection/Evaluation
23	Forklift damage to active steam lines with radiological contamination and asbestos concerns	DECM (DECN) - Forklift transfer of poly tanks	PW (PRO)	PHE / RAD / CHM	NM (BN) / NM (RE) / NM (CE)	3/3/3	05-Feb-97	ORO--LMES-PGDPENVRES-1997-0002 Forklift Damage to Active Steam Lines
24	Worker contaminated via pin hole tear within the Centerline Chainveyor Gloveport glove. Gloves hadn't been replaced since 1988	DECM - Removal of size-reduced parts from a glove-box for bag-out operations	HC (IWK/CON)	RAD	RSC (skin)	2	01-Feb-97	RFO--KHLL-PUFAB-1997-0012 Skin Contamination Due To Pin Hole Tear in Module J Centerline Chainveyor Glove During Deactivation Activities
25	Discovery of contaminated mouse droppings during shelving and lockers removal	DEAC - Activities to transition B-Plant facility to shutdown, shelving and lockers removal	FB (LC)	BIO / RAD	NM (V) / NM (RSC)	4/4	23-Jan-97	RL--PHMC-BPLANT-1997-0001 Contaminated rodent droppings
26	Non-compliance with radiological protection training requirements	DECM - Decommissioning activities at the facilities	HC (T)	RAD	NM (RSC)	4	24-Jan-97	OEWS 97-05 (PAAA-1) (1) Noncompliance with Radiological Protection Training Requirements
27	Non-compliance with radiological protection training requirements	DECM - Decommissioning activities at the facilities	HC (T)	RAD	NM (RSC)	4	24-Jan-97	OEWS 97-05 (PAAA-1) (2) Noncompliance with Radiological Protection Training Requirements
28	Non-compliance with radiological protection training requirements	DECM - Decommissioning activities at the facilities	HC (T)	RAD	NM (RSC)	4	24-Jan-97	OEWS 97-05 (PAAA-1) (4) Noncompliance with Radiological Protection Training Requirements
29	Non-compliance with radiological protection training requirements	DECM - Decommissioning activities at the facilities	HC (T)	RAD	NM (RSC)	4	24-Jan-97	OEWS 97-05 (PAAA-1) (5) Noncompliance with Radiological Protection Training Requirements
30	Wooden panel fell approx. 20 ft. missing worker by 15 ft.	DECM - Loading a debris shredder	AH (HI)	PHT	NM (IT)	3	15-Jan-97	OH-AB-RMI-RMIDP-1997-0002 Wooden panel fell approximately 20 feet missing site worker by 5 feet while loading the debris shredder.
31	Container tilted during offloading, spilling contaminated sediment	DECM - Hoisting and rigging activities offloading hauling container of contaminated sediment	AH (HA)	RAD	REC	4	12-Dec-96	RL--BHI-NREACTOR-1996-0024 Contaminated Sediment Spill
32	A backhoe struck an energized 440V power line during demolition	DECM (DEMO) - Backhoe operations during demolition	AH (HI)	PHE	NM (ES)	3	16-Oct-96	RL--PHMC-300NE-1996-0001 Struck energized electrical line while removing concrete overburden.
33	While transporting acid tank scrap metal offsite, worker exposed on left arm to residual sodium hydroxide from tank piping	DECM - Tank demolition	AH (HI)	CHM	CSC (skin)	3	3-Oct-96	RL--BHI-NREACTOR-1996-0018 Procedural Violation Results in Minor Exposure to Sodium Hydroxide
34	Pressure washer inappropriately used to clean PPE and face shield	DECM (DECN) - Pressure washer use for decon. activities	PW (PRO)	PHT	NM (IT)	3	20-Sep-96	ORO--MK-WSSRAP-1996-0017 (2) Repeated Violation of Pressure Washing Procedures; Near Miss Personnel Injuries
35	Electrical power provided to shears using a defective/untested power cord	DECM - Cutting using hydraulically operated shears	HC (IWK/CON)	PHE	NM (ES)	2	30-Sep-96	OH-FN-FDF-FEMP-1996-0054 Improperly Energized Electrical Equipment

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
36	Urinalysis tests for worker exposed to unknown radium source were conducted 9 months after sample collection because site lab did not have a validated method of radiobioassay; worker terminated employment and site had no way to follow-up	DEAC - Deactivation activities	HC (IWK/CON)	RAD	RIC	1	1-Apr-95	OH-MB-EGGM-EGGMAT01-1996-0019 Occupational Exposure
37	Oil tank dropped during crane operation when cable came free from becket and wedge	DECM - Crane operations moving oil tank	PW (CC)	PHT	NM (IT)	4	30-Aug-96	RL--BHI-NREACTOR-1996-0017 184-NB Day Storage Bunker Oil Tank Rigging Incident
38	Contaminated hose used for vacuuming contaminated storage tank waste was discovered hanging over the boundary of a temporary radiological control area.	DECM - Vacuuming activities	HC (IWK/CON)	RAD	REC	4	14-Aug-96	ORO--LMES-Y12WASTE-1996-0004 Contaminated Hose Discovered Outside A Radiological Area
39	Security guard boot contaminated as result of inadequate contamination control area that allowed contaminated particle distribution into clean area.	DEAC - ROVER area of Bldg. CP-640 is an inactive process facility undergoing deactivation to remove residual fissile material.	DW	RAD	RSC (boot)	3	11-Aug-96	ID--LITC-PHASEOUT-1996-0007 Shoe Contamination at CPP-640 (ROVER)
40	Working in High Rad. Area without proper dosimetry and under wrong RWP	DECM (DECN) - Painting/applying fixative to removed and contaminated monolith and removal of high exposure rate hardware	HC (IWK/CON)	RAD	NM (RE)	2	27-Jul-96	RL--BHI-NREACTOR-1996-0014 (1) Work Process Stand-down at N-Basin due to Work Control Issues
41	Working in High Rad. Area without proper dosimetry and under wrong RWP	DECM (DECN) - Painting/applying fixative to removed and contaminated monolith and removal of high exposure rate hardware	HC (IWK/CON)	RAD	NM (RE)	3	28-Jul-96	RL--BHI-NREACTOR-1996-0014 (2) Work Process Stand-down at N-Basin due to Work Control Issues
42	P-10 gas was released when worker accidently opened a tank valve while trying to remove the tank cap with a screwdriver during new P-10 gas tank installation	DECM - Removing tank cap	DW	CHM	CEC	3	15-Jul-96	OH-AB-RMI-RMIDP-1996-0010 P-10 Gas Escape from lab cylinder.
43	Worker fell through roof	DECM (DEMO) - Demolition of Hydrofluorination Plant	PW (HE)	PHT	NM (STF/IT)	2	11-Jul-96	OH-FN-FERM-FEMP-1996-0038 Effective Use of Personal Fall Protection Equipment
44	Worker wore previously contaminated boot; contamination detected when worker existed controlled area	DECM (DEMO) - Demolition activities	HC (IWK/CON)	RAD	RSC (shoe)	3	10-Jul-96	OH-FN-FERM-FEMP-1996-0037 Personal Clothing Contamination
45	4 rad areas detected on deteriorated road surface located outside of controlled area undergoing D&D (ARA-1 and 2 are locations of past reactor projects/programs)	DECM (DECN) - D&D of area	FB (LC)	RAD	REC	4	20-Jun-96	ID--LITC-CFALL-1996-0002 Discovery of radioactive contamination outside of controlled area
46	Mercury-contaminated soil found	DECM (DISM) - Excavation of underground hazardous waste storage tank closure and removal of aux. piping system	FB (LC)	CHM	NM (CE)	4	20-Jun-96	SAN--LLNL-LLNL-1996-0026 Elemental Mercury Discovered in Soil During RCRA Closure (B-419)
47	Standard methodology of smear to curie to determine contamination levels for transmit panel was incompatible for porous material being sampled	DECM (CHAR) - Sampling/characterization of porous material	HC (IWK/CON)	RAD	NM (RE)	4	12-Jun-96	SR--WSRC-ERF-1996-0002 Inadequacy of Smears to Determine Currie Content for Free Release Criteria for Tritiated Waste

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
48	Evacuated personnel were not accounted for, site monitoring was not conducted, and all systems were not declared safe after a gamma alarm system was inadvertently activated	DECM - Decommissioning activities at facility	PW (PRO)	RAD	NM (RE)	4	24-May-96	OH-AB-RMI-RMIDP-1996-0008 Inadvertent Alarming of the Gamma Alarm System in the RF-6 Building.
49	Mercury droplets discovered during management overview in 4 boiler instrument cabinets	DEAC - Boiler Monitor Panel and Master Control Panel deactivation as part of the 284W facility shutdown	HC (IWK/CON)	CHM	NM (CE)	3	17-May-96	RL--WHC-KHS&W-1996-0006 Mercury spill at 284 West powerhouse
50	Authorization bases not up to date, including SARs, OSRs/TSRs	DEAC - Deactivation activities at facilities	AH (HA)	None	None	None	21-May-96	RFO--KHLL-SITEWIDE-1996-0002 (2) Evaluation of Building Operational Safety Requirements Identified Multiple Violations
51	Worker cut cable which caused a counterweight to fall close to a co-worker	DECM - Cutting cables	PW (PRO)	PHT	NM (IT)	2	17-May-96	RL--BHI-NREACTOR-1996-0013 Near Miss at 1715-N4 Diesel Oil Storage Tank
52	Failure to conduct and provide weekly inspection reports to the state violated RCRA Permit	DECM - Decommissioning activities at facility	FB	None	None	None	1-Apr-96	OH-AB-RMI-RMIDP-1996-0006 (1) Failure to conduct RCRA Permit required weekly Hazardous Waste Storage inspection.
53	Failure to conduct and provide weekly inspection reports to the state violated RCRA Permit	DECM - Decommissioning activities at facility	FB	None	None	None	22-Apr-96	OH-AB-RMI-RMIDP-1996-0006 (2) Failure to conduct RCRA Permit required weekly Hazardous Waste Storage inspection.
54	Deficiencies found in authorization basis	DECM (DECN) - N-Basin and Redox facilities	AH (HI)	None	None	None	07-May-96	RL--BHI-GENAREAS-1996-0003 Suspension of the N-Basin Stabilization Project and Installation of Remote Monitoring Equipment Activity at Redox (202-S)
55	Contamination seeped through zipper and pant leg seem of PPE during cleaning of small leaks on outside of feed tank lines	DECM (DECN) - Decontamination of the Out-of-Tank evaporator at bldg. 7877	HC (IWK/CON)	RAD	RSC (clothing)	3	01-May-96	ORO--ORNL-X10CHEMTEC-1996-0001 Contamination- Company Clothing
56	Supervisor PPE and shoe contamination detected after having entered "wet work" area with inappropriate PPE	DECM - Monitoring activity	PW (PRO)	RAD	RSC (shoes/clothing)	3	30-Apr-96	OH-FN-FERM-FEMP-1996-0025 Personnel Shoe Contamination
57	Worker did not change outer anti-c gloves after touching contaminated tie-off ropes thus contaminating chir with contaminated inner anti-c gloves.	DECM - 105-N Basin decommissioning activities	PW (PRO)	RAD	RSC (skin)	2	26-Apr-96	RL--BHI-NREACTOR-1996-0008 Skin Contamination at105-N Basin
58	A worker's shoe contaminated in Rad Buffer Area after having walked over legacy contamination spread down walls and weather enclosure by rain through leaking roof	DECM - Worker viewing work activities from RBA from inside temporary weather shelter at 202-S	FB (LC)	RAD	RSC (shoe)	3	25-Apr-96	RL--BHI-DND-1996-0010 Contaminated Shoe In The Temporary Weather Shelter at 202-S
59	Worker shoes contaminated after exiting 202-S Bldg.; contamination detected before workers left Rad Buffer Area	DECM - Decommissioning activities at 202-S	FB (LC)	RAD	RSC (shoes)	3	25-Apr-96	RL--BHI-DND-1996-0009 Contaminated Shoes At 202-S
60	Pipe and tree removal activities disturbed deteriorated drums containing PCB oil resulting in a spill.	DECM - Leaking drum removal from storage pond Raffinate Pit #4	HC (IWK/CON)	CHM	CEC	3	22-Apr-96	ORO--MK-WSSRAP-1996-0004 (2) PCB contaminated oil spill at suspect PCB area with inraffinate pit #4 - half of a reportable quantity exceeded
61	Worker sprayed with contaminated water when a pressurized line (PVC piping) broke where it threads into a valve	DECM - Restart activities for sediment extraction from the 105-N Bldg. Basin	AH (HI)	RAD	RSC (skin/clothing)	2	21-Mar-96	RL--BHI-NREACTOR-1996-0007 Person Contamination at 105-N Basin
62	Contamination detected inside a test reactor's steam muffler piping	DECM (CHAR) - Hazard identification activities (surveying and document inspection) prior to Heavy Water Component Test Reactor demolition and decommissioning.	FB (LC)	RAD	NM (RE)	4	6-Mar-96	SR--WSRC-ERF-1996-0001 Contaminated Steam Muffler

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
63	Criticality potential - Flange leak of potentially fissionable material	DECM (DECN) - 202-S Building North Sample Hood Area decontamination	AH (HI)	RAD	NM (RE)	2	11-Mar-96	RL--BHI-DND-1996-0006 202-S Flange Leak of potentially fissionable material from flange in North Sample Gallery
64	Assessment team members entered contaminated area without recognizing rad postings, wearing PPE or reading/signing rad work permit	DECM - 105-N Basin HQ tour as part of HQ RL assessment	PW (PRO)	RAD	NM (RE)	3	01-Mar-96	RL--BHI-NREACTOR-1996-0004 Failure to observe radiological postings results in procedural violation
65	Contractors used a jackhammer within 5 ft of a previously marked utility line; a violation of the contract-stipulated guideline that only hand tools be used within 5 ft. of known utilities-resulted in stop work order	DECM (DEMO) - Excavation to expose duct work and electric utility concrete encasement to break up and remove a concrete pad	PW (PRO)	PHE	NM (ES)	4	14-Feb-96	ALO-LA-LANL-NUCSAFGRDS-1996-0001 (1) DOE Facility Representative Initiated Stop Work Due to Safety Concerns for a D&D Project
66	Contamination detected during courtesy surveys of the inside of wooden green fuel storage boxes stored in a non-posted radiological	DEAC - Courtesy surveys activities before removal	FB (LC)	RAD	NM (RE)	4	07-Feb-96	RL--BHI-NREACTOR-1996-0003 Legacy Contamination Attributed to Past Practices
67	Worker cut live fire system alarm relay wire because work package had not identified wire in junction box	DEAC - Deactivation of electrical systems to the 1712-N Bldg.	AH (HI)	PHE	NM (ES)	4	06-Feb-96	RL--BHI-NREACTOR-1996-0002 Inadequate Work Package And Lack Of Configuration Control Of Facility Drawings
68	Worker glove burned when kerosene vapors ignited in a drum during thermal desorption process to treat waste material	DECM - Organic halides removal	HC (IWK/CON)	PHE	FE / BN (glove)	2	31-Jan-96	ORO--BNI-FUSRAPCISS-1996-0001 Flash occurred during thermal treatment of oily matrix
69	Notice of Penalty and fine given by WA Dept of Eco. for dangerous waste management practices, training deficiencies assessed when a 55-gal drum lid ejected due to unexpected pressure buildup.	DEAC - 183-H Basins Closure Project	AH (HI)	PHT	NM (IT)	3	18-Sep-95	RL--BHI-DND-1996-0002 Notice of Penalty from Washington Department of Ecology (WDOE) related to 183-H Basins Closure Project
70	Sparks emitted from an electrical grinder contacted pre-filter resulting in smouldering fire and filter degradation--workers did not install safety shield	DEAC - Cutting operations for removal of vessel 106 from the CPP-640 ROVER Mechanical Handling Cave	HC (PRO)	PHE	FE	4	01-Jan-96	ID--LITC-PHASEOUT-1996-0001 Preliminary Notice of Violation and Proposed $25,000 Civil Penalty (OEWS)
71	Sprinkler line (safety system) freeze-up due to continued operation of exhaust fan	DECM - Safe Shutdown activities of unoccupied building areas	DW	None	None	None	11-Dec-95	OH-MB-EGGM-EGGMAT04-1995-0026 Sprinkler Line Freeze - M Building, Rooms 47 & 48 (OEWS)
72	Subcontractor cut through a 120 volt energized electrical wire	DECM (DECN) - Equipment (electrical circuitry) removal in TA 21	PW (HE)	PHE	ES	2	01-Dec-95	ALO-LA-LANL-LANL-1995-0015 A subcontract worker received a mild electrical shock by cutting through a 120 volt energized electrical wire.
73	Deactivation of the fire protection system caused unexpected release of water	DEAC - Deactivation of the fire protection system	HC (PRO)	None	None	None	27-Oct-95	RL--BHI-NREACTOR-1995-0012 Fire Protection System Degradation
74	Contaminated grease and oil detected on worker PPE after worker entered top pit (outside of original work scope) to disassemble roller; PPE pant leg had ridden up cloth booties when workers knelt	DECM (DISM) - Roller disassembly activities	PW (PRO)	RAD	RSC (clothing)	3	26-Oct-95	RFO--KHLL-NONPUOPS1-1995-0024 #1857/ Personal Protective Clothing Removable Beta Contamination
75	Flash fire from band saw heat reacting with H off-gas produced by residual HF in pipe	DECM (DISM) - Pipe cutting of Anhydrous Hydrofluoric Acid System in Plant 4	HC (PRO)	CHM / PHE	CE / FE / NM (BN)	2	26-Oct-95	OH-FN-FERM-FEMP-1995-0122 Flash Fire Occurs on Construction Project (OEWS)
76	Workers contaminated when removing and packaging radioactive material from an incinerator glovebox.	DECM - Removal of waste packages for disposal from 232-Z Bldg.	DW	RAD	RIC / RSC	1/2	23-Oct-95	RL--WHC-PFP-1995-0055 During the performance of waste handling operations four individuals became contaminated.
77	Rad control tech detected contamination in uncontrolled areas during survey.	DECM (DECN) - Decontamination operations at TA-21-152	FB (LC)	RAD	NM (RSC)	4	06-Oct-95	ALO-LA-LANL-TSF-1995-0005 Historical Contamination Discovered in an Uncontrolled Area During Decontamination and Decommissioning Activities

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
78	Two workers got contaminated when contaminated water leaked from a hose being moved from one radioactive material area to another.	DECM (DECN) - Moving a hose	HC (PRO)	RAD	RSC	3	25-Sep-95	RL--BHI-DND-1995-0010 Contamination of Clothing at 1304-N Emergency Dump Tank
79	Shipped waste inspection revealed waste drums were packaged incorrectly in violation of Procedure #4.2	DECM (DECN) - 183-H Solar basin cleanup activities for final RCRA closure	PW (PRO)	RAD / CHM	NM (RE) / NM (CE)	4/4	21-Sep-95	RL--BHI-DND-1995-0008 Improperly Package Mixed Waste Drums
80	Contaminated paint clumps found 6" outside Posted Cont. Area - not cleaned up after performing work	DECM (CHAR) - Routine Rad Con surveys in 100-N spacer silo prior to equipment removal	HC (IWK/CON)	RAD	REC	4	20-Sep-95	RL--BHI-NREACTOR-1995-0013 Contaminated Paint Clumps at 100-N Spacer Silo
81	Two workers contaminated during a waste operation of a deactivation project	DEAC - Waste operation of a deactivation project	PW (EF)	RAD	RSC	2	19-Sep-95	RL--WHC-PFP-1995-0050 After disposing of radiologically contaminated waste into a drum, two operators performed a self-survey and found contamination
82	Workers touched contaminated equipment during removal for cleaning activities	DECM (DECN) - Removal of table from underwater storage to cleaning station	HC (IWK/CON)	RAD	RSC (skin)	2	13-Sep-95	RL--BHI-NREACTOR-1995-0010 Personnel Skin Contamination
83	Rad waste shipped off WSRC site to public landfill	DECM (DEMO) - 232-F waste containers shipment to clean, off-site landfill	PW (PRO)	RAD	REC	4	17-Aug-95	SR--WSRC-ERF-1995-0011 Sanitary Landfill (Offsite) Potential Contamination Levels
84	Subcontractor used wrong equipment for rigging.	DECM - Rigging operations	HC (T)	PHT	NM (IT)	4	17-Aug-95	ORO--MK-WSSRAP-1995-0015 Improper rigging used to empty sludge boxes at temporary storage area (TSA)
85	Worker's clothing got contaminated while holding waste bag against his body	DECM - Holding waste bag	PW (PRO)	RAD	RSC (clothing)	3	24-Aug-95	RL--BHI-DND-1995-0006 Contamination of Modesty Clothing at the 1304-N Emergency Dump Tank
86	Structural inspector's personal shirt got contaminated from wearing a still contaminated overall from the laundry	DECM - Structural inspection	AH (HI)	RAD	RSC (clothing)	3	24-Aug-95	CH-AA-ANLE-ANLEER-1995-0012 Personnel Contamination at EBWR
87	Contamination penetrated 4 layers of PPE due to profuse sweating and prolonged time on hands and knees	DECM (DECN) - Tape removal from contaminated surface (seams in floor) in Bldg 200 hot cell	AH (HA)	RAD	RSC (skin)	2	17-Aug-95	CH-AA-ANLE-ANLEER-1995-0010 Personnel Contamination
88	Workers sprayed while cutting into a pressurized process water line	DECM (DISM) - Tank line cutting for inactive tank isolation before removal	AH (HI)	CHM	CIC	2	16-Aug-95	ORO--LMES-X10ENVRES-1995-0002 Pressurized Process Water Line Cut During T-30 Tank Removal Project (OEWS)
89	Loss of control of rad material	DECM - EBWR D&D	DW	RAD	NM (RSC)	4	26-Jul-95	CH-AA-ANLE-ANLEER-1995-0008 EBWR Loose Contamination
90	Rad control area had narrowed w/o RADCON postings changes so sample vials containing rad material were brought outside of RCA	DEAC (CHAR) - Building 35/59 deactivation activities	PW (PRO)	RAD	NM (RE)	4	24-Jul-95	OH-MB-EGGM-EGGMAT03-1995-0008 Building 35/59- Discovery of Contaminated Items
91	Worker touring 331 shell D&D project stepped inside contaminated boundary and contaminated shoe	DECM - Touring 331 shell D&D	HC (IWK/CON)	RAD	RSC (shoe)	3	20-Jul-95	CH-AA-ANLE-ANLEER-1995-0007 Shoe contamination at EBWR [EM-40].
92	Backhoe operations broke an 8" underground potable water fire protection water main releasing 2,600 gals potable water into Los Alamos Canyon.	DECM (DEMO) - Underground footing removal at TA-21-4 South	DW	RAD	REC	4	19-Jul-95	ALO-LA-LANL-DPWEST-1995-0006 Eight-Inch Water Line Break Released Potable Water to the Storm Water Drainage into Los Alamos Canyon
93	Mercury leak discovered from abandoned hydrogen line connected to abandoned process in Bldg 9201-4	DECM (CHAR) - Characterization in building 9201-4	AH (HI)	CHM	CEC	4	07-Jun-95	ORO--MMES-Y12ENVRES-1995-0002 Hazardous Material Release - Mercury (OEWS)
94	Worker shoes contaminated by smearable alpha contamination in change room	DECM - 232-Z waste packages removal in scrubber cell	HC (IWK/CON)	RAD	RSC (shoes)	3	30-May-95	RL--WHC-PFP-1995-0026 Seven individuals were found to have contamination on their shoes in the change room of Building 232-Z

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
95	Hydraulic fluid (40 gals of oil) released from a broken backhoe line of a Link-Belt Backhoe during debris transport	DECM (DECN) - Stabilization of north wall of Bldg183-H with debris	PW (EF)	CHM	CEC	4	25-May-95	RL--BHI-DND-1995-0005 Hydraulic Fluid Release
96	Winch on personnel lifting device used to lift worker in/out of sump failed when plunger locking pin did not engage.	DECM (DECN) - Sump decontamination	AH (HI)	PHT	NM (STF)	4	14-May-95	ORO--BNI-FUSRAP-1995-0004 Failure of Personnel Retrieval Lifting Device
97	Radioactive material found in loudspeaker used by wasps to build a nest using contaminated mud.	DECM - 212-N decommissioning activities	AH (HI)	RAD	REC	4	04-May-95	RL--WHC-KHELEC-1995-0010 212-N radioactive contamination
98	Worker regulator separated from supplied air mask during pipe cutting and removal	DECM - Pipe cutting and removal	PW (PRO)	RAD	NM (RIC)	3	03-May-95	RL--WHC-PFP-1995-0023 During decontamination and decommissioning activities in Building 232-Z an operator's regulator separated from the supplied air mask.
99	Support structures removal for steam lines and secondary electrical conductors resulted in the detachment of a 6 ft wooden pole from an iron rack to fall 17 ft. to grd.	DEAC - Support structures removal	DW	PHT	NM (IT)	2	07-Apr-95	RL--WHC-KHELEC-1995-0007 Steam line D & D near miss
100	A loaded dump truck overturned on its side	DECM - Dump truck operations	DW	PHT	NM (IT)	4	21-Mar-95	RL--BHI-REMACT-1995-0002 Vehicle Accident
101	Clothing contamination	DECM - Decommissioning activities	DW	RAD	RSC (clothing)	3	25-Mar-95	OH-FN-FERM-FEMP-1995-0033 Personal Clothing Contamination
102	Probe cutting operations required probe to be moved to a glove box, which was unavailable, necessitating a special RWP; probe bag inadvertently cut during probe cutting	DEAC - Activities to determine contamination levels leaving the PUREX canyon required the replacement of a sample probe	DW	RAD	RE	3	6-Mar-95	RL--WHC-PUREX-1995-0006 Improper Work Practices
103	Procedure not followed resulting in an unauthorized removal of tritium contaminated cabinet	DEAC - Removal of tritium contaminated cabinet	PW (PRO)	RAD	NM (RE)	3	24-Feb-95	ALO-PI-MMSC-PINELLAS-1995-0003 Deviation of procedure involving the removal of excess equipment (OEWS)
104	Worker opened fire protection system valve rather than a water valve setting off fire alarm, which did not sound in 5 of 8 bldgs (incorrect amerage fuse had been installed)	DECM (DISM) - Dye test activities of an acid waste lines	DW	None	None	None	01-Feb-95	ALO-LA-LANL-DPWEST-1995-0003 When inadvertently activated, the fire alarm system did not function per design due to an incorrectly replaced fuse
105	Skin contamination after worker removed gloves to operate power tools	DECM - Operating power tools	PW (HE)	RAD	RSC	2	17-Jan-95	ALO-LA-LANL-DPWEST-1995-0001 Personal Skin Contamination of a JCI worker involved in the decontamination and decommissioning of TA-21
106	Worker's clothing got contaminated when decontaminating a containment tent	DECM (DECN) - Decontaminating a containment hut	DW	RAD	RSC (clothing)	3	06-Dec-94	RL--WHC-TANKFARM-1994-0066 Personal clothing became contaminated during containment decontamination work at tank BY-109
107	Rubble pile was found to be contaminated with asbestos	DECM - Decommissioning activities	DW	CHM	NM (CE)	3	5-Dec-94	HQ--URA-SSCL-1994-0005 Friable asbestos contamination found at rubble pile.
108	Breathing zone sample results indicated that two workers were above DAC concentrations	DECM (DECN) - Decontamination activities	PW (PRO)	RAD	RIC	1	04-Nov-94	CH--RMI-RMIDP-1994-0004 Breathing zone sample results for two employees were above DAC concentrations.
109	Contaminated decontamination equipment moved to storage before sludge material was fully characterized	DECM - Disposition of equipment at 105-R Bldg	AH (HI)	RAD	NM (RSC)	4	04-Nov-94	SR--WSRC-REACR-1994-0008 Equipment Contamination Determined to be Hazardous
110	Rad contamination on hand	DECM - Building 330 decommissioning activities	PW (PRO)	RAD	RSC (hand)	2	26-Oct-94	CH-AA-ANLE-ANLEER-1994-0014 Personnel Contamination - Building 330
111	Skin contamination due to improper egress process.	DECM - Decommissioning activities	PW (PRO)	RAD	RSC (hand)	2	30-Sep-94	RL--BHI-DND-1994-0003 Skin Contamination
112	Workers showed positive rad intake from fecal sample analyses	DECM - EBWR D&D	DW	RAD	RIC	1	9-Sep-94	CH-AA-ANLE-ANLEER-1994-0009 (2) Positive Bioassay Results - EBWR D&D Project (EM 40)

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
113	Demolition of a ceiling caused contaminated dust to fall on the workers and a guard who entered the area and got his shoes contaminated	DECM (DEMO) - Demolition of a ceiling	DW	RAD	RSC (shoes)	3	01-Sep-94	ALO-DA-EGGM-EGGMAT02-1994-0010 Contamination of Construction Personnel (OEWS)
114	Plastic (rather than standard wooden) pallet slipped off of a fork truck while moving computer equipment	DECM - Equipment removal	HC (IWK/CON)	PHT	NM (IT)	4	30-Aug-94	HQ--URA-SSCL-1994-0004 Fall of pallet of computer equipment from storage rack in warehouse.
115	Radioactive contamination found in clean areas in former tank storage area and near an emergency pump room	DECM (CHAR) - Performing characterization surveys as part of R Reactor D&D	FB (LC)	RAD	NM (RE)	4	6-Jul-94	SR--WSRC-REACR-1994-0003 (1) Radioactive Contamination Found in Clean Area
116	Radioactive contamination found in clean areas in former tank storage area and near an emergency pump room	DECM (CHAR) - Performing characterization surveys as part of R Reactor D&D	FB (LC)	RAD	NM (RE)	4	7-Jul-94	SR--WSRC-REACR-1994-0003 (2) Radioactive Contamination Found in Clean Area
117	Radioactive contamination found in clean areas in former tank storage area and near an emergency pump room	DECM (CHAR) - Performing characterization surveys as part of R Reactor D&D	FB (LC)	RAD	NM (RE)	4	1-Aug-94	SR--WSRC-REACR-1994-0003 (5) Radioactive Contamination Found in Clean Area
118	Radioactive contamination found in clean areas in former tank storage area and near an emergency pump room	DECM (CHAR) - Performing characterization surveys as part of R Reactor D&D	FB (LC)	RAD	NM (RE)	4	3-Aug-94	SR--WSRC-REACR-1994-0003 (6) Radioactive Contamination Found in Clean Area
119	Radioactive contamination found in clean areas in former tank storage area and near an emergency pump room	DECM (CHAR) - Performing characterization surveys as part of R Reactor D&D	FB (LC)	RAD	NM (RE)	4	5-Aug-94	SR--WSRC-REACR-1994-0003 (7) Radioactive Contamination Found in Clean Area
120	Construction carpenter received punctured wound when extending a containment hut	DECM - Extending a containment hut	AH (HI)	PHT	PC (hand)	2	21-Jun-94	SR--WSRC-HCAN-1994-0081 Puncture Wound to Construction Worker in USF Prep.
121	Unexpected contamination found during demolition of the duct system	DECM (DEMO) - Demolition of duct system	AH (HI)	RAD	NM (RE)	4	15-Jun-94	ORO--MKFO-X10CONSTRM-1994-0007 Loss of control of radiological contamination in a non posted area, Work Order 4368, Subcontract Number 476 (OEWS)
122	Natural gas leak from a utility line that was improperly purged during a demolition job	DECM (DEMO) - Demolition activities	DW	PHE	NM (FE)	3	28-Apr-94	HQ--GOPE-PETC-1994-0002 Natural Gas Leak
123	X-ray examination at adjacent facility set off alarms	DECM (SAMP) - Sampling activities	DW	RAD	NM (RE)	3	22-Apr-94	SR--WSRC-SLDHZD-1994-0008 Stack CAM Alarm
124	Rad contamination to skin of left elbow during process pipe cutting when worker sweated through PPE	DECM - Worker cutting process piping and operating a bobcat in controlled area of Bldg 403	AH (HA)	RAD	RSC (skin)	2	20-Apr-94	ORO--MK-WSSRAP-1994-0020 Skin Contamination Discovered on left elbow of subcontractor employee
125	Worker tore forearm area on sleeve of PPE allowing contamination to transfer to his sweatshirt	DECM (DECN) - Cleaning vent stacks	PW (HE)	RAD	RSC (clothing)	3	11-Jan-94	ORO--BNI-FUSRAPCISS-1994-0002 Personnel Clothing Contamination
126	Contamination found on forearm of worker PPE after worker came into repeated contact with unencapsulated rad material on ductwork	DECM (DEMO) - Removing process duct work	HC (IWK/CON)	RAD	RSC (clothing)	3	11-Apr-94	ORO--FERM-FEMP-1994-0017 Personnel Clothing Contamination
127	Load binding when small plate contacted vessel lug causing cables to overload and fail	DECM (DISM) - Transfer of EBWR core assembly from reactor vessel to fuel pond for size reduction and packaging using a crane lift	DW	RAD	REC	3	31-Mar-94	CH-AA-ANLE-ANLEER-1994-0002 Sling Breakage on Removal of EBWR Core Assembly
128	Release of uncharacterized rad materials in exhaust duct triggered a "high level" alarm during dismantlement of an obsolete HEPA filter housing.	DECM (DISM) - Dismantlement of an obsolete HEPA filter housing	AH (HI)	RAD	NM (REC)	4	11-Mar-94	ORO--MMES-Y12DEFPGM-1994-0008 Stack No. 13 Release
129	Contaminated clothing during hot cell work	DECM (DECN) - Hot cell work	HC (IWK/CON)	RAD	NM (RE)	3	14-Mar-94	CH-AA-ANLE-ANLEEWM-1994-0001 Personnel Contamination in Building 200 M-wing Hot Cell (EM-40)

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
130	Rad contamination of safety shoe during decommissioning work	DECM - Decommissioning work	HC (PRO)	RAD	NM (RE)	3	08-Mar-94	ID--EGG-ERATAN-1994-0001 Contamination of safety shoe
131	Filter housing leaked on disassembled primary contained wet filter housing during transport	DECM (DECN) - Disassembly and decon of ventilations system	HC (PRO)	RAD	REC	4	17-Feb-94	ORO--MMES-X10ENVIOHP-1994-0001 Spill of 8 ozs of Rad/Perchlorate Contaminated Wash Water
132	Floor fan found contaminated	DECM - Decommissioning activities	HC (IWK/CON)	RAD	NM (RE)	2	16-Feb-94	SR--WSRC-RMAT-1994-0004 (1) Contaminated Fan in a Clean Area
133	Air reversal from airborne contamination area to area where no respiratory protection required.	DECM - Decommissioning of 221 HUSF	AH (HI)	RAD	NM (RIC)	3	08-Feb-94	SR--WSRC-HCAN-1994-0021 Air Reversal in 221-HUSF/D&D
134	Workers hands contaminated during air filter change out activities	DECM - Air filter change out activities	HC (IWK/CON)	RAD	RSC (skin)	2	07-Feb-94	ALO-LA-LANL-DPWEST-1994-0001 Four Contractor Personnel Received Radioactive Contamination on Hands.
135	Construction personnel failed to verify the absence of locks and tags prior to moving a switch.	DECM - K cooling tower activities	PW (PRO)	PHE	NM (ES)	3	01-Feb-94	SR--WSRC-POD-1994-0006 Lock/Tag Violation at K-Cooling Tower
136	Uncharacterized rad material piled up outside controlled area from a demolition job.	DECM (DEMO) - Demolition activities	PW (PRO)	RAD	NM (RE)	3	01-Feb-94	CH-BH-BNL-PE-1994-0002 Radioactive material discovered outside controlled area
137	Worker hit head when window suddenly loosened in attempts to remove window casing with a pry bar	DECM (DISM) - Removing window casing	AH (HI)	PHT	IT (head/neck)	1	14-Jan-94	ORO--MK-WSSRAP-1994-0003 Subcontractor employee neck strain
138	Sprinkler head frozen caused leakage	DECM - Facility decommissioning	HC (PRO)	None	None	None	17-Jan-94	ALO-DA-EGGM-EGGMAT02-1994-0001 Sprinkler Head Freeze Leakage
139	Cadmium exposure limits exceeded during torch cutting operations	DECM - Torch cutting operations	DW	CHM	CE	3	12-Jan-94	ORO--BNI-FUSRAPCISS-1994-0001 Exposure limits exceeded for cadmium.
140	Contaminated clothing	DECM - Decommissioning activities	PW (PRO)	RAD	RSC (boots)	3	11-Jan-94	ORO--MK-WSSRAP-1994-0002 Subcontractor employee discovered contamination on his right personal work boot at the access control point
141	Alpha contamination detected on equipment and surfaces in uncontrolled area after removal of contaminated copper cooling water piping	DECM (DISM) - Removal of contaminated copper cooling water piping	AH (HI)	RAD	RE	3	3-Jan-94	ALO-LA-LANL-CMR-1994-0001 Radioactive contamination detected on equipment and surfaces in an uncontrolled area in the attic of Wing 7 of CMR
142	Spill of hydraulic fluid from damaged crane	DECM (DECN) - Crane being deconed on Bldg 301 pad after dismantlement / demolition work at Bldg 201/301	PW (PRO)	CHM	CEC	2	20-Dec-93	ORO--MK-WSSRAP-1993-0041 Subcontractor crane damaged during demobilization
143	Fire cutting of duct containing contaminated materials	DECM (DISM) - Cutting operation using power saw	AH (HI)	RAD	NM (RE)	3	17-Dec-93	ALO-LA-LANL-DPWEST-1993-0003 Small Fire in a Radiologically Controlled Area
144	Employee's clothing contaminated	DECM (DECN) - Employee dry wiping area of pipe runs in preparation for DECM of contaminated equipment	HC (IWK/CON)	RAD	RSC (clothing)	3	02-Dec-93	ORO--FERM-FEMP-1993-0068 Clothing Contamination
145	Rated capacity and breaking strength exceeded for 3/8" wire sling due to wt miscalc. during load transfer- load fell	DECM (DEMO) - Transfer of cylindrical portion of silo from one of 2 roller carts to concrete floor using a 5-ton gantry crane	AH (HA)	PHT	NM (IT)	3	17-Nov-93	ORO--FERM-FEMP-1993-0067 Item Deemed Worthy of Reporting: Wire Rope Sling Failure Resulting in a Dropped Load
146	Employee's clothing contaminated	DECM (DECN) - Employee washing down interior of Plant 7 with high pressure sprayer	HC (IWK/CON)	RAD	RSC (clothing)	2	07-Oct-93	ORO--FERM-FEMP-1993-0061 Personnel Contamination
147	Worker exposed during bag weighing due to unnoticed tear in bag containing contaminated shelving	DECM - Bagging/removing metal shelves from glove box	HC (PRO)	RAD	RSC (skin)	2	22-Sep-93	CH-AA-ANLE-ANLEEWM-1993-0011 Hand Contamination in Building 212 (EM-40)
148	Water sampling update activities revealed oil leak from turbine pump	DECM - Bldg 309 emergency cooling water supply well	FB (LC)	CHM	CEC	4	20-Sep-93	RL--WHC-WHC300NE-1993-0005 309 building Emergency water supply well

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
149	Drain line hose of ice barrel got tangled and ruptured valve causing leakage of water and spread of contamination	DECM - Removal of demister equipment	PW (HE)	RAD	NM (RE)	3	16-Sep-93	SR--WSRC-HCAN-1993-0088 Contaminated Water In Second and First Level of the 221-H Canyon.
150	Haul truck with defective weld on hook lift attachment dropped load	DECM (SAMP) - Haul truck dumping of roll-off boxes contents at TSA	PW (EF)	PHT	NM (IT)	4	07-Sep-93	ORO--MK-WSSRAP-1993-0037 Haul truck incident caused work activities to be limited
151	Exhaust blew contamination onto forearm of worker's PPE, which soaked through because worker was sweating profusely	DECM (DECN) - Removal of process piping using reciprocating saw	HC (IWK/CON)	RAD	RSC (skin)	2	30-Aug-93	ORO--MK-WSSRAP-1993-0036 Contamination discovered on left elbow of subcontractor employee from work activities in building 201
152	Radioactive source (Sr-90) was misplaced and not found	DECM (CHAR) - Calibration source was used to support characterization activities	HC (IWK/CON)	RAD	NM (RE)	3	27-Aug-93	RL--WHC-WHC100EM-1993-0011 Missing/Lost Radioactive Source
153	Five workers received contamination on chins and necks	DECM (DEMO) - Removal of contaminated building debris as part of Demolition of Bldg 301	HC (IWK/CON)	RAD	RSC (skin-neck) / RIC	2/1	18-Aug-93	ORO--MK-WSSRAP-1993-0031 Radioactive contamination discovered on subcontractor workers' necks during work activities in building 301
154	Rad Contamination breached PPE and reached worker's legs because of excessive sweating inside PPE and poor lifting practices	DECM (DISM) - Removal of contaminated process piping and lifting reactor lids	HC (IWK/CON)	RAD	RSC (skin-thighs)	2	13-Aug-93	ORO--MK-WSSRAP-1993-0028 Subcontractor employee with skin contamination - left and right thighs
155	HP worker came into contact with contaminated stopper	DECM - Plugging glove box cooling water line	HC (IWK/CON)	RAD	RSC (shoes)	3	11-Aug-93	CH-AA-ANLE-ANLEEWM-1993-0009 Shoe Contamination in Room DL-216 of Building 212 (EM-40)
156	Ten subcontractors received uranium uptake	DECM (DECN) - Remediation of building 201 product process pipe removal and cleaning	HC (IWK/CON)	RAD	RIC / RSC (skin)	1/2	1-Jun-93	ORO--MK-WSSRAP-1993-0025 Internal contamination - subcontractor workers
157	Backup generator failed to start during power outage	DECM - Shutdown activities at BCL Decommissioning Project maintenance crew attempted to manually start generator after it failed to start	PW (EF)	None	None	None	1-Jul-93	CH--BMI-BCLDP-1993-0001 (1) Electrical Power Loss
158	Asbestos waste laden with mercury inadvertently sent to Y-12 landfill	DECM (DECN) - Removal of material asbestos from the 9201-4 fan room	HC (IWK/CON)	CHM	CEC	3	15-Jun-93	ORO--MMES-CENTENGY12-1993-0002 Improper Characterization of Hazardous Waste
159	Safety supervisor not on site. Several safety problems found: working without fall production and not tied off other workers exhibited heat stress symptoms	DECM (DECN) - Asbestos abatement around boiler in preparation for removal operations	PW (PRO)	PHT	NM (STF)	3	23-Jun-93	ORO--MK-WSSRAP-1993-0021 (2) Work Package 255 Shutdown
160	Worker received contamination due to wearing company furnished and laundered protective clothing that were contaminated	DECM (DECN) - Removal of miscellaneous objects from vent duct servicing cell 3	HC (IWK/CON)	RAD	RSC (skin)	2	17-Jun-93	SAN--RI-RIHL-1993-0002 Personnel Contamination During RIHL Remediation
161	Uncharacterized substance removed prior to sampling/ inspection	DECM - Decommissioning of 185/190B pump house complex	PW (PRO)	CHM	NM (CE)	2	13-May-93	RL--WHC-WHC100ERD-1993-0002 Missing Five Gallon Glass Container with Approximately 1 inch of Unknown Liquid.
162	Fuel oil sludge in bottom of 50,000 gal fuel oil tank ignited from torch cutting slag	DECM (DISM) - Torch cutting and removal of fuel oil tank at WRRTF facility	HC (PRO)	PHE	FE	3	10-May-93	ID--EGG-ERP-1993-0001 Fire at WRRTF-753 Tank Removal Project
163	Worker's shoe contaminated after coming in contact with contaminated pallet	DECM (DECN) - Movement of 8 legacy waste packages using forklift	HC (IWK/CON)	RAD	RSC (shoes)	3	26-Apr-93	RL--WHC-PFP-1993-0026 While moving legacy waste the shoes of two operators were contaminated and the moving pallet was found to be contaminated.
164	Water was used in cleanup activity and transported contamination to worker's shoe	DECM (DECN) - Wiping down the inner walls of disabled exhaust plenum	PW (PRO)	RAD	RSC (shoes)	3	21-Apr-93	ALO-LA-LANL-SIGMA-1993-0002 Personnel Shoe Contamination

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
165	During removal of protective clothing, worker brushed against contaminated air hose	DECM (DECN) - Beginning of entry decontamination activities in Cell M-3, Building 200	HC (IWK/CON)	RAD	RSC (pants/shirt)	3	13-Apr-93	CH-AA-ANLE-ANLEEWM-1993-0004 (1) Contamination of Workers in Cell M-3 of Building 200
166	During removal of protective clothing, worker brushed against contaminated air hose	DECM (DECN) - Beginning of entry decontamination activities in Cell M-3, Building 200	HC (IWK/CON)	RAD	RSC (pants/shirt)	3	15-Apr-93	CH-AA-ANLE-ANLEEWM-1993-0004 (2) Contamination of Workers in Cell M-3 of Building 200
167	3 workers received internal incidental uptakes of tritium during tritiated waste processing activities	DECM - Tritium recovery demonstration closeout activities for the NP-MHTGR	DW	RAD	RIC	2	02-Apr-93	ID--EGG-ATRNPR-1993-0002 Internal uptake of tritium
168	Worker's neck contaminated by drops of condensation from upper door of air lock	DECM (DECN) - Decontamination of airlock crane using a high pressure water spray	AH (HI)	RAD	RSC (skin)	2	09-Mar-93	RL--PNNL-PNNLNUCL-1993-0014 Personnel Contamination Found on the Back of Staff Member's Neck Upon Exit from Airlock
169	Imbalanced water chemistry resulted in galvanic action which accelerated corrosion of fuel element	DEAC - Transfer of Janus reactor fuel to Building 330	PW (EF)	RAD	NM (RE)	3	25-Feb-93	CH-AA-ANLE-ANLEER-1993-0003 Chemical reaction on aluminum surfaces of JANUS reactor fuel.
170	Worker's shoe covers came off and metal fragments contaminated his boots	DECM (DISM) - Removal of hot cell equipment using cutting torch	DW	RAD	RSC (boots)	3	18-Feb-93	CH-AA-ANLW-AL-1993-0006 Contaminated Shoes
171	Removed overhead power lines	DECM - Removing old overhead power lines near UO3 plant	FB (LC)	RAD	NM (RSC)	4	16-Feb-93	RL--WHC-WHC200EM-1993-0012 Contaminated Overhead Wire
172	Freezing caused dry pipe sprinkler system (safety system) pipe tee to brake	DEAC - Post-deactivation at inactive building	DW	None	None	None	11-Feb-93	ID--EGG-TRA-1993-0002 Unplanned Outage Of A Service System
173	Actuation of fire alarm due to tripping fire protection sprinkler systems pressure switch resulting in 2 occurrences of false alarms. The fire protection maintenance personnel were not immediately notified after 1st event, allowing 2nd event to occur.	DECM - Removal of branch line on TA-21 fire sprinkler system to accommodate D&D work, requiring running water through the system	FB	None	None	None	10-Feb-93	ALO-LA-LANL-DPWEST-1994-0002 (2) Precautionary Evacuation in Response to a Fire Alarm Initiated by an Actuation of a Pressure Switch for a Reason Other Than a Fire
174	Alpha contamination detected on equipment above allowable limits	DECM - Survey conducted of decontamination vacuum pump prior to movement after use	FB (LC)	RAD	NM (RSC)	3	04-Jan-93	SR--WSRC-HCAN-1993-0002 Contamination Found On Kelly Decontamination System #2 Vacuum Pump
175	Bldg fire detection and alarm upgrades were not documented correctly; fire alarm was manually activated in response to a Zone 21 alarm condition, though no fire had occurred and personnel were evacuated	DEAC - Facility in deactivation	PW (HE)	None	None	None	29-Dec-92	RL--WHC-308-1992-0006 308 Building Fire Alarm
176	Leakage from roll-off box containing yellow cake due to wet debris in box from application of water during demolition	DECM (DEMO) - Surveillance of building areas between Building 201 and 301 as part of demolition activities	AH (HI)	RAD	REC	3	19-Dec-92	ORO--MK-WSSRAP-1992-0033 Uranium Leak at Bldg.301 and at the Material Staging Area (MSA)
177	Workers exposed to CO from gas and diesel fuel equipment used indoors during uranium-contaminated materials removal	DECM - Uranium-contaminated materials removal	HC (IWK/CON)	CHM	CEC	2	18-Dec-92	ALO--GEO-GJO-1992-0018 (2) Potential Carbon Monoxide exposure in excess of OSHA Standards.
178	A cutting torch spark ignited wood within the frame of insulated metal ductwork located in debris/waste pile	DECM (DECN) - Waste metal was being cut to size in Building 301 for disposal	PW (HE)	PHE	FE	3	10-Dec-92	ORO--MK-WSSRAP-1992-0030 Chemical plant building 301 incident fire
179	Subcontractors melted lead located around drain pipe without proper PPE	DECM (DISM) - Removal of drain pipe located in 773-F ladies change room	DW	CHM	NM (CIC)	3	08-Dec-92	SR--WSRC-LTA-1992-0059 Subcontractor Performing Work with Hazardous Material Without the Proper Procedure

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
180	Personnel received contamination through protective clothing because of excessive moisture on clothing	DECM (DECN) - Decontamination of Lab hot cell and dolly trench areas using Kelly vacuum system	HC (IWK/CON)	RAD	RSC (skin)	2	05-Nov-92	ID--EGG-ERATRA-1992-0007 Personnel Skin Contamination
181	Work scope changed such that electrical conduit required removal-electrical wire inadvertently severed causing loss of power	DECM - Removal of conduit in CP-5 Bldg. in order to remove lead shielding from process piping	PW (CC)	PHE	NM (ES)	4	22-Oct-92	CH-AA-ANLE-ANLEEWM-1992-0004 Loss of electrical power during decommissioning and decontamination activities at CP-5 (Building 330)
182	Workers misunderstood instructions and removed active sprinkler head before plugging causing discharge of water at 60 psi, tripping fire alarm	DECM (DECN) - Capping of inactive utility lines located in Room 209 in preparation for D&D of AH-1 and AH-2	PW (PRO)	PHT	NM (IT)	4	06-Oct-92	SAN--EMO-LEHR-1992-0002 Utility water line leak
183	Employee's hip discovered to be contaminated when he returned to work the day after work was performed	DECM (DECN) - Decontamination of ANL-W analytical Labs metallurgical cell	HC (IWK/CON)	RAD	RSC (skin)	2	25-Sep-92	CH-AA-ANLW-AL-1992-0005 Contamination of Contractor Employee
184	Operator finger discovered to be contaminated as well as two chairs in old HB -line supply room	DECM (DECN) - Escorting 2 operators from old HB-line supply room to change rooms	FB (LC)	RAD	RSC (skin)	2	24-Sep-92	SR--WSRC-HCAN-1992-0073 Contamination Found on Finger of An "Old HB-Line" Operator
185	Radiological contamination spread outside regulated area	DECM (DECN) - Maintenance of high-level cleaners in Plant 2/3	PW (PRO)	RAD	RSC (clothing)	3	13-Sep-92	ORO--WMCO-FEMP-1992-0093 Confirmed Clothing Contamination.
186	Perspiration soaked through wrapping tape allowing workers wrist to become contaminated	DECM (DECN) - Decontamination of valve by buffing surface with grinder at K-1420	HC (IWK/CON)	RAD	RSC (skin)	2	10-Sep-92	ORO--MMES-K25GENLAN-1992-0074 Detectable Contamination On Employee At K-1420 - Site Program Mgmt.
187	Worker contaminated on right elbow after having perspired through Anti-C PPE and contacting contaminated surface	DECM (DECN) - Manual decon of a 6" G-17 valve at K-1420	HC (IWK/CON)	RAD	RSC (skin)	2	31-Aug-92	ORO--MMES-K25GENLAN-1992-0068 Detectable Contamination on Employee At K-1420 - SPO
188	Worker (untrained in asbestos mgmt) exposed to asbestos-contaminated boot covers during boot cover decn and water used to clean boots was not treated before release to raffinate pit	DECM (DECN) - Boot cover decontamination	HC (IWK/CON)	CHM	CSC / CEC	3	27-Aug-92	ORO--MK-WSSRAP-1992-0013 Inappropriate cleaning of removable boot covers potentially contaminated with asbestos fibers
189	Worker shoe contaminated and contamination spread from 2 inadequately sealed pipes that had dripped water into a steam header line	DECM (DECN) - Decontamination activities	HC (IWK/CON)	RAD	RIC / RSC	1/2	27-Aug-92	SR--WSRC-HCAN-1992-0062 Contamination Above RCA Limits in Section 2 Stairwell
190	Previously undetected particles of fixed contamination were found on 2 wood power poles	DECM - Removal of power poles at the surplus warehouse, after being removed from the ARA-I Facility	HC (IWK/CON)	RAD	NM (RSC)	4	06-Aug-92	ID--EGG-POWER-1992-0001 Contaminated Power Pole.
191	Spilled UNH	DEAC - Transferring bucket of UNH solution from leaking tank to be drained	HC (IWK/CON)	RAD	RSC (clothing)	3	10-Jul-92	ORO--WMCO-FEMP-1992-0073 Confirmed contamination to company issued clothing
192	Worker' s pantleg contaminated when the extension cord of a vacuum cleaner used to clean the contaminated areas of overheads fell against worker's leg after worker left the Contamination Area	DEAC - Cleaning contaminated area	HC (IWK/CON)	RAD	RSC (clothing)	3	09-Jul-92	ORO--WMCO-FEMP-1992-0072 Confirmed contamination to company-issued personnel clothing.
193	Unauthorized entry into a controlled area	DECM - BCL Decommissioning Project	PW (PRO)	RAD	NM (RE)	3	01-Jul-92	CH--BMI-BCLDP-1992-0007 Unauthorized Entry Into A Controlled Area

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
194	5 ml of contaminated water found outside controlled area due to improper sealing of cracks of door during misting activities	DECM (DISM) - Ceiling tile removal that involved use of water misting for dust suppression in Room 306 of old HB-Line	HC (IWK/CON)	RAD	NM (RSC)	3	25-Jun-92	SR--WSRC-HCAN-1992-0043 Contaminated Water Found in The RCA of 221-H Canyon
195	Cracks with contamination discovered on an exhaust fan in a RCA--crack was result of fatigue of the fan housing from age and vibration	DECM (CHAR) - Conducting characterization activities	PW (EF)	RAD	NM (REC)	3	12-Jun-92	SR--WSRC-HCAN-1992-0039 Crack in #2 Old HB-Line Exhaust Fan Housing
196	Workers sprayed with contaminated sediment when a pressurized pumpline was disconnected	DECM (DECN) - Sediment removal process in Bldg. 3001 Storage canal Closure	AH (HI)	RAD	RSC (Skin)	2	09-Jun-92	ORO--MKFO-X10CONSTRM-1992-0011 Personnel Contamination
197	Technician cut into a 1/4" plastic instrument tube that was pressurized with 90 psi air	DEAC - Disconnecting, cutting and removal of glovebox tubing and lines in Building 773-A in preparation for D&D	PW (PRO)	PHT	NM (IT)	4	4-Jun-92	SR--WSRC-LTA-1992-0023 Lock, Try, and Tag Violation in 773-A / F-055 Facility
198	During refueling the welder's carburator leaked, causing contamination of ground	DECM - Refueling of gas-powered welder as part of decommissioning of facility	PW (EF)	CHM	CEC	4	28-May-92	RL--WHC-WHC200ERD-1992-0005 Unleaded gasoline spill
199	Shipment of wastes did not comply with DOE moratorium on hazardous waste shipping	DECM - Removal of light ballast contaminated with PCB being shipped offsite	PW (PRO)	CHM	NM (CEC)	3	22-May-92	SAN--RI-SSFL-1992-0003 Off-Site Shipment of Hazardous Waste
200	Worker received contamination on finger	DECM - Removal of contaminated boxes from old HB-line	PW (HE)	RAD	RSC (skin)	2	14-May-92	SR--WSRC-HCAN-1992-0032 Skin Contamination
201	During cutting operations, worker severed cable resulting in actuation of radiation alarm	DECM (DEMO) - Removal of concrete floor using power saw in Building 2026	FB	PHE	NM (ES)	3	22-Apr-92	ORO--MKFO-X10CONSTRM-1992-0006 Subcontractor Technician Severed Monitoring Cable with Concrete Saw
202	Contamination was found on worker's jacket and hard hat due to issuance of contaminated clothing by company	DECM (DEMO) - Subcontractor performing demolition inside Analytical Laboratory	HC (IWK/CON)	RAD	RSC (coat)	3	17-Mar-92	ORO--WMCO-FEMP-1992-0023 Confirmed radiological contamination to coat pocket of company issued work coat to subcontractor at Laboratory Demolition Project.
203	Opening of air-operated valve allowed instantaneous pressure relief on acid line causing three workers to be sprayed with one gallon of sulfuric acid (causing acid burn)	DECM - Flushing acid supply line in preparation for planned decommissioning and removal of line in Utilities Building	AH (HA)	CHM	CSC (skin)	1	03-Mar-92	ALO-PI-GEND-PINELLAS-1992-0010 Personnel Exposure to Sulfuric Acid
204	Three chairs located in uncontrolled area were found to be contaminated	DECM (CHAR) - Conducting routine surveys of equipment and furniture in laboratory/office area	FB (LC)	RAD	NM (RSC)	3	17-Feb-92	CH--BMI-BCLDP-1992-0004 Failure to Report an Abnormal Event Involving Detection of Contamination in an Uncontrolled Office.
205	Box containing characterization samples was inappropriately left overnight in vehicle that was burglarized, causing relocation of box to adjacent vehicle	DEAC (CHAR) - Transport of building characterization smears and samples to West Jefferson radiological Chemistry Lab	HC (PRO)	RAD	NM (RSC)	3	05-Feb-92	CH--BMI-BCLDP-1992-0001 Absence of procedure for chain of custody of building characterization samples
206	Worker ripped latex glove while removing fume hood allowing hand to become contaminated	DECM (DEMO) - Removal of fume hood in room N-19 as part of renovation of Analytical Facility	HC (IWK/CON)	RAD	RSC (hand)	2	21-Jan-92	ORO--WMCO-FEMP-1992-0007 Confirmed Personnel Skin Contamination
207	Emergency eye wash line froze and broke allowing chlorinated water to be discharged to creek	DEAC - Diesel generator operation	AH (HI)	CHM	CEC	2	16-Jan-92	ORO--MMES-X10BRESRX-1992-0002 Potable water spill into creek.

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
208	Underground portion of fire protection piping system broke about 20 feet outside facility exterior wall producing a hole beneath the asphalt paving	DECM (DECN) - Facility idle	PW (EF)	RAD	NM (REC)	4	30-Dec-91	SAN--RI-RIHL-1992-0001 RIHL Fire Protection/Safety Water Line Failure
209	HPs detected airborne radioactivity in building corridors due to stagnant air created during filter changing	DECM (DISM) - DOP testing of HEPA filter in old HB Line Room 311	HC (IWK/CON)	RAD	NM (RE)	3	19-Dec-91	SR--WSRC-HCAN-1991-1063 Airborne Activity in East Corridor of Old HB-Line.
210	26-pound Halon cylinder discharged when smoke detector failed	DECM (DISM) - Old HB-Line is undergoing dismantlement and decontamination	PW (EF)	PHE	NM (APH)	4	16-Dec-91	SR--WSRC-HCAN-1991-1062 Activation of Fire Suppression System in Old HB-Line Room 311-C
211	Rolling mill found to be contaminated	DEAC (CHAR) - Radiological characterization of equipment items in mealworking area of Building 2 North Bay	FB (LC)	RAD	NM (RSC)	3	24-Oct-91	CH--BMI-BCLDP-1991-1004 Detected Contamination on Rolling Mill
212	Survey indicated Beta contamination on walls and floors in excess of LANL administrative limits	DECM (DECN) - Radiation surveys of building TA3-21 as part of decontamination activities	FB (LC)	RAD	NM (RSC)	3	21-Aug-91	ALO-LA-LANL-CMR-1991-1010 Loss of Control of Radioactive Material Within a Controlled Area in Excess of Established Guidelines.
213	Plastic covering on door fell down allowing contamination on door	DECM (DECN) - HP survey of door separating D&D activities in Old HB-Line from New HB-Line	HC (PRO)	RAD	NM (RSC)	3	20-Aug-91	SR--WSRC-HCAN-1991-1033 Contamination found in a "clean" Area
214	Contamination penetrated worker (paper suit) PPE and contamination was found on his right knee	DECM - Disconnecting piping from sump pump	HC (IWK/CON)	RAD	RSC (Skin)	2	05-Aug-91	ORO--MMES-X10METCER-1991-1004 Personnel Contamination
215	Sheen of oil noticed on water course from storm sewer	DECM - Wire cables and capacitors coated with oil stored outside of SM-105 during building decommissioning	HC (PRO)	CHM	CEC	4	02-Aug-91	ALO-LA-LANL-SHERWOOD-1991-1562 Oil Sheen in water course
216	Asbestos debris from abatement activities was potentially dislodged during process high pressure gas venting activities	DECM - Asbestos abatement of cable mesh ceiling with process pressure testing activities in room below	DW	CHM	NM (CIC)	3	02-Aug-91	ALO-KC-AS-KCP-1991-1025 Potential asbestos exposure
217	Chemical spill from 3 bottles occurred during a forklift operation when a pipe on a pallet hooked the cabinet within which the chemical bottles were stored	DEAC - Forklift operations	HC (IWK/CON)	CHM	CEC	3	24-Jul-91	ALO-KO-SNL-TA3COYOTE-1991-1005 Hazardous Materials Spill.
218	Chain was found cut that locked out a valve and the 2 previous monthly surveillances on locked out valves had not been conducted	DEAC - Interim stabilization of chemical sewer line used to divert PUREX chemical sewer to B-Pond	PW (PRO)	CHM	NM (CEC)	3	Jun, Jul, & Aug 91	RL--WHC-TANKFARM-1991-1030 (1) Potential lock and tag procedure violation at 216-A-29-A diversion box
219	Small point source of radioactive contamination discovered on concrete bunker	DECM - Removal of 13 ton concrete bunker from top of tank TAN/TSF 777B	PW (HE)	RAD	NM (RE)	3	17-Jul-91	ID--EGG-ERP-1991-1003 Radiological Incident-Point source was discovered on a concrete bunker transported to CFA bulky waste landfill.
220	Radiologically contaminated boiler released/sold	DECM - Surplus item disposal	PW (HE)	RAD	REC	3	06-Dec-89	CH--BMI-BCLDP-1991-1001 Unauthorized Release to Environment of Suspected Contaminated Boiler
221	Closure plan deficiencies	DECM - Chromic acid tank D&D	DW	CHM	NM (CEC)	4	1-Jul-91	ORO--MMES-PORTESHD-1991-1030 x-700 Chromic Acid Tank Closure Plan "Notice of Deficiencies" by Ohio EPA --PTS-91 -465--
222	Technician cut into live 110 volt wire with diagonal cutter, causing molten metal to splash against worker's forehead	DECM - Removal of electronic equipment from electrically shielded room at CTR	PW (PRO)	PHE / PHT	NM (ES) / IT	2	20-Jun-91	ALO-LA-LANL-ACCCOMPLEX-1991-1539 Cross-catagory item. A near-miss to one of the reporting classifications.
223	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (2) Previous loss of contamination control occurrences not recognized as reportable.

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
224	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (4) Previous loss of contamination control occurrences not recognized as reportable.
225	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (5) Previous loss of contamination control occurrences not recognized as reportable.
226	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (7) Previous loss of contamination control occurrences not recognized as reportable.
227	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (8) Previous loss of contamination control occurrences not recognized as reportable.
228	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (15) Previous loss of contamination control occurrences not recognized as reportable.
229	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (21) Previous loss of contamination control occurrences not recognized as reportable.
230	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (22) Previous loss of contamination control occurrences not recognized as reportable.
231	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (23) Previous loss of contamination control occurrences not recognized as reportable.
232	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (24) Previous loss of contamination control occurrences not recognized as reportable.
233	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (28) Previous loss of contamination control occurrences not recognized as reportable.
234	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (30) Previous loss of contamination control occurrences not recognized as reportable.
235	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (33) Previous loss of contamination control occurrences not recognized as reportable.
236	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (35) Previous loss of contamination control occurrences not recognized as reportable.
237	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (36) Previous loss of contamination control occurrences not recognized as reportable.
238	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (42) Previous loss of contamination control occurrences not recognized as reportable.
239	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (43) Previous loss of contamination control occurrences not recognized as reportable.
240	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (44) Previous loss of contamination control occurrences not recognized as reportable.
241	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (46) Previous loss of contamination control occurrences not recognized as reportable.
242	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (47) Previous loss of contamination control occurrences not recognized as reportable.
243	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (48) Previous loss of contamination control occurrences not recognized as reportable.
244	Loss of contamination control	DEAC - Transitioning to shutdown	FB (LC)	RAD	REC	3	31-Oct-90 through 20-May-91	RL--BHI-NREACTOR-1991-1012 (50) Previous loss of contamination control occurrences not recognized as reportable.
245	During removal operations, segments of highly irradiated and clad nuclear fuel were discovered but were not part of the nuclear material inventory for the Analytical Lab MBA	DECM (DECN) - Removal of radioactive materials from Analytical Laboratory Hot Cells	FB (LC)	RAD	RE	3	6-Nov-91	CH-AA-ANLW-AL-1991-1001 (2) Fissile Material Found in Hot Cells
246	Leakage of fuel from diesel generator being used to supply power to core drill	DECM - Core drilling inside basins to support decommissioning activities	HC (IWK/CON)	CHM	CEC	4	26-Apr-91	RL--WHC-WHC100ERD-1991-1002 Diesel fuel spill
247	Worker's air hose became disconnected causing a loss of breathing air	DECM (DECN) - Decontamination of floors and walls of room 305	PW (EF)	None	None	None	23-Apr-91	SR--WSRC-HCAN-1991-1006 Loss of Breathing Air to Plastic Suit Due to Air Hose Coming Detached

TABLE A15 - D&D-Related Occurrences Analysis Results

#	Occurrence Description	Work Type	ES&H Deficiency	Hazard	ES&H Consequence	Signficance Ranking	Date of Occurrence	ORPS Number ORPS Title
248	Improper system isolation valves used for draining pressurized water system causing filtration system leakage contaminating clean system	DECM - Draining pressurized water system	AH (HA)	RAD	REC	3	18-Apr-91	RL--BHI-NREACTOR-1991-1004 Filtered Water Line Contamination
249	Leak occurred in plastic coupling of fire hose due to age and inactive use	DECM - Whirly pump was used to draw down contaminated lift station sump in N-Reactor building	PW (EF)	RAD	REC	4	18-Mar-91	RL--BHI-NREACTOR-1991-0220 Contaminated water leak outside/surface contamination area
250	For 6 years, HEPA filters had been DOP tested annually which exceeded the operational safety requirements for 200-F and 200-H of every 9 months	DECM (DISM) - DOP testing of HEPA filters in old HB-Line in effort to reduce contamination levels	HC (PRO)	RAD	NM (REC)	3	08-Mar-91	SR--WSRC-HCAN-1991-0034 (5) OSR Surveillance Requirement Violation - Old HB-Line
251	Excessive smoke generated during cutting which carried contamination to workers in high bay area	DECM (DISM) - Removal of NaK line on SNAP reactor vacuum vessel using cutting torch	AH (HI)	RAD	RIC	2	25-Feb-91	SAN--ETEC-T059-1991-0001 Unfiltered Smoke Release
252	Individuals crawling on knees received contamination through small holes created in suits from excessive friction	DECM (DECN) - Workers performing decontamination work in 324 building shielded materials facility	HC (IWK/CON)	RAD	RSC (skin)	2	15-Feb-91	RL--PNNL-PNNLNUCL-1991-0016 Personnel Skin Contaminations.
253	Breaker tripped due to internal electrical problem causing loss of power to Building 189-D	DECM - Decommissioning of the 189-D facility	PW (EF)	PHE	NM (ES)	4	13-Jan-91	RL--WHC-WHC100ERD-1991-0037 Loss of power to189-D Building
254	Sub-freezing temperatures caused safety shower and fire protection water supply lines to freeze and break	DECM - Building idle	AH (HI)	None	None	None	22-Dec-90	SAN--RI-SSFL-1991-0001 Fire Protection/Safety Water Line Freezing/Breakage
255	Low temperatures and isolation of heating system in building caused moisture in deluge valve air lines to freeze causing dry sprinkler to become charged with water	DEAC - Building is vacant and in Dry Standby	PW (EF)	None	None	None	21-Dec-90	RL--BHI-NREACTOR-1990-0369 1101N Deluge Valve Trip Charging Fire System Wit Water
256	Worker's shirt cuff became contaminated through contact with smearable contamination	DECM (DECN) - Handling and removal of radioactive materials in a fume hood in Room 309 of Building 325	HC (IWK/CON)	RAD	RSC (clothing)	3	19-Oct-90	RL--PNNL-PNNLNUCL-1990-0013 Radioactive contamination found on a 325 Building staff member's personal clothing.
257	Cleaning out storage cabinet filled with contaminated materials	DECM - Equipment removal	HC (IWK/CON)	RAD	RSC (shoes)	3	27-Sep-90	ORO--MMES-X10BRESRX-1990-0116 Contamination on shoe.